

System 2

USER GUIDE



Pi System 2 User Guide

Part Number: 29K-071089-3E

Version 3.0, January 1999

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Introduction

Welcome to the Pi System 2 User Guide. This Guide is the core documentation for the installation and use of Pi System 2.

References are made in this Guide to the Club *Expert* PC (Personal Computer) software, which can be used with most laptop computers. The Club *Expert* software allows you to compare the performance of both the car and the driver to previous outings, or outings from another car.

This Guide has been divided into sections to help you become familiar with the system quickly and easily.

If System 2 has already been fitted to your car, you can get a general idea of the features available within each operating mode (Race mode, Telltale mode, etc.) by looking at the 'Overview' section. A summary of how System 2 is likely to be used in practice is given in the section 'At the track'.

If you are installing System 2 yourself, you will need to follow the instructions given in the 'Installation notes' section before proceeding.

The User Guide is divided into the following sections:

- Overview**
- At the track**
- Configuring the dash**
- Using System 2**
- Troubleshooting**
- Installation notes**

About this User Guide

This version of the System 2 User Guide covers dash features up to dash version 3.80. It includes details of sensors available for use on the two User channels.

The User Guide also includes application notes for a number of specific racing applications, such as rallying and karting. There are also notes for cars that have sequential gearboxes or with serial data streams available on their engine management systems.

Overview

What is System 2?

This section gives an overview of System 2, its features, variants and configuration modes.

Read this section before you use System 2 as an engineer or driver. You will also find it useful to refer to it at the beginning of each race, until you are thoroughly familiar with the system.

System 2 is an integrated digital dashboard and data logger.

Each System 2 includes:

- a dash,
- a car loom,
- a wheel speed sensor,
- an RPM box,
- two temperature sensors,
- two pressure sensors,
- an installation kit, and
- a System 2 User Guide.

The following options are available:

- backlighting,
- external buttons and warning lights,
- ECM links (to Engine Management Systems),
- a Beacon kit,
- Club *Expert* series of software for data analysis,
- Additional sensors for the two User channels, and
- an interface for monitoring sequential gearbox position.

The dash

The dash itself forms the central part of System 2. Included in the dash is the digital display, logging memory, two control buttons, back-up battery, accelerometer (for g-force), dash temperature sensor and a power supply for the sensors.

The dash has been designed to monitor, display and log the following parameters:

- Speed
- RPM
- Lap times (Beacon kit required)
- Oil temperature
- Water temperature
- Dash temperature
- Oil pressure
- Fuel pressure
- Car battery voltage
- Cornering g-force
- User channel 1 & 2.

The dash also has two lights on the front panel: an over-rev light (or gear-change light) that comes on when the RPM goes over the red line, and an Alarm light that flashes if any of the sensors exceed preset alarm thresholds.

Logged data can be viewed on the dash or downloaded to a printer, or to a computer (with optional Club *Expert* series of software).

The dash normally logs for up to 42 minutes. However, by reducing the logging rate, a maximum of 105 minutes can be logged before the memory in the dash fills up. See the section 'Configuring the dash', for details.

The User channels can be used to measure a range of parameters:

- Thermocouples for measuring Exhaust Gas Temperature (EGT);
- Temperatures for additional gearbox or differential temps;
- Potentiometers for steering or throttle position.

The fuel and oil pressure channels can also be configured to measure lower turbo or carburettor pressures (0–40psi).

The Beacon kit

The Beacon kit provides the following benefits:

- Fixed lap times or elapsed stage times
- Lap counter
- Lap time telltales
- Lap markers for the Club *Expert* series of software.

The Beacon kit allows an accurate registration of each lap passed. The kit consists of an infrared detector mounted on the car and an infrared transmitter mounted on the pit wall.

As the car passes the transmitter, the infrared signal is picked up by the detector on the car. The dash immediately displays the lap time for the driver, as well as storing information for each lap for later analysis with the Club *Expert* series software.

As well as displaying the time and count for each lap, the Beacon kit enables System 2 to store and display the maximum/minimum readings for each of the sensors per lap (the telltales).

If you are intending to use the Club *Expert* range of software, you will need a Beacon kit, since the software displays data by lap.

The Club **Expert PC** software

A powerful feature of System 2 is the data analysis software that can be run on a laptop PC. The Club *Expert* range of PC software (Club *Expert plus*, Club *Expert super* and Corner Analysis Program (CAP)) offers a wide range of features, including:

- Circuit maps
- Graphs of RPM and speed
- Lap-by-lap reports on pressures, temperatures, voltage and Dash temperature
- Graphs of lateral g-force
- Information about the track, driver and date
- Speed reports that compare performance with other cars or drivers
- An RPM logbook kept over the life of the engine
- An archiving facility for saving logged data on floppy discs for future analysis
- Full printing facilities.

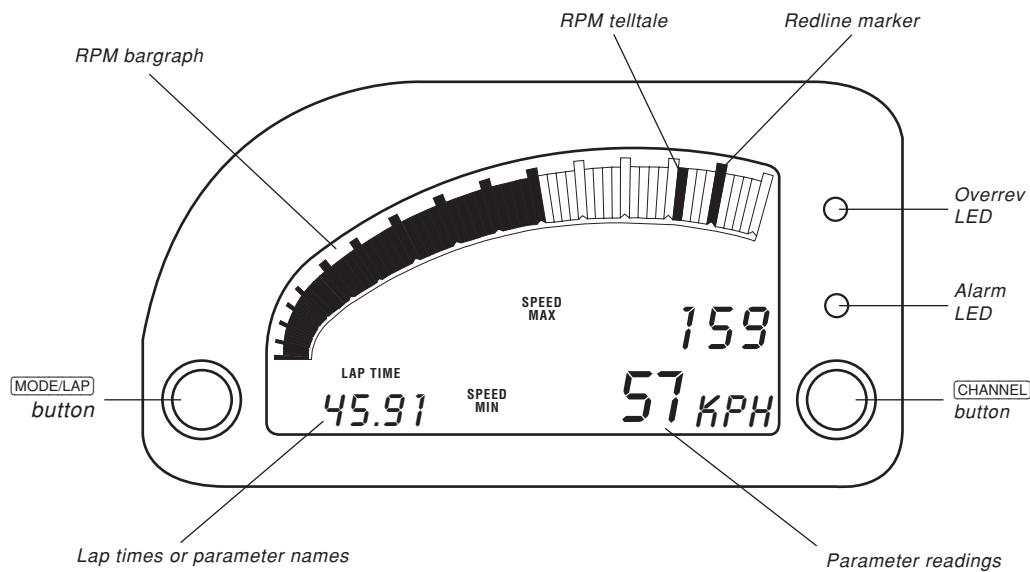
When plugged into the car at the end of an outing, the software transfers (i.e. *downloads*) all the data stored in the dash. This data can then be used as the basis of a series of reports. For example, while the car prepares for its next outing, you can be comparing lap times for different suspension settings, tyres, or even drivers.

Club *Expert plus* can also provide split time reports, on-power histograms, compare elapsed time, gear ratio, in-line g and graphs of analog channels.

Club *Expert super* allows the use of Set-up and Running sheets, multiple graphing, beacon move facility, overlaid histograms, animation, and configurable lap threshold.

Corner Analysis Program (CAP) uses steering, speed and acceleration channels to produce a Speed Influence graph, Steering Sensitivity, Intra-corner behaviour graph, map report and g-g diagram.

Conventions



BUTTON PRESS	TIME (seconds)					EXAMPLE
Click	0	0.5	1	1.5	2	Click CHANNEL to cycle through Pages in Real-time mode
Press and Hold						Press and Hold both CHANNEL and MODE/LAP to enter Configuration mode
Double click						Double click MODE/LAP for Reset option

Definitions of button presses

System 2 modes

The dash automatically switches into one of four different operating modes depending on whether the car is stationary, is being driven, or has just returned from an outing. These operating modes are:

- Power up mode,
- Real-time mode,
- Race mode, and
- Telltale mode.

In addition to the four normal operating modes, a Configuration mode exists for you to adjust alarm thresholds (e.g. for low oil pressure or high oil temperature), the RPM red line setting and the other parameters.

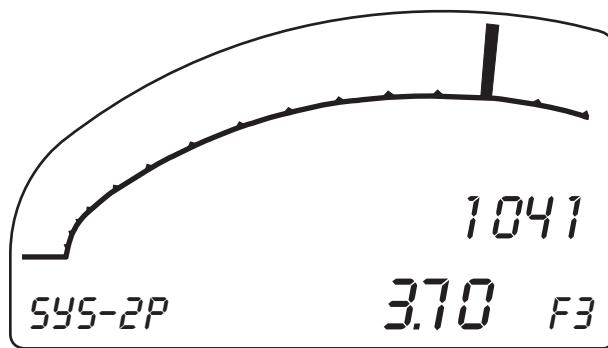
Configuration mode

System 2 is preprogrammed with default settings, but it may be necessary to alter these values to suit your car.

Some of these parameters only need to be set once when System 2 is installed. However, you may wish to adjust parameters such as the RPM over-rev light or the battery voltage alarm level more frequently.

Details of how to configure System 2 are given in the ‘Configuring the dash’ section of this guide, together with a list of the parameters you can change.

Power up mode



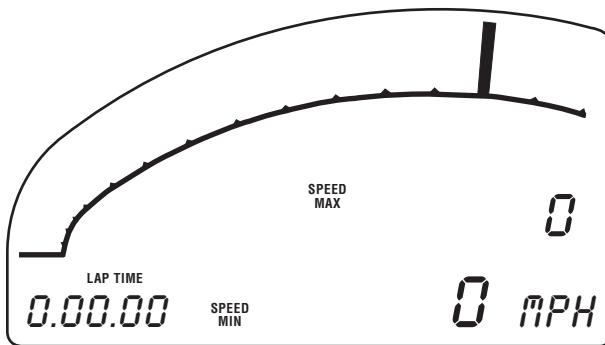
When power is first switched on, information is displayed for about three seconds. This includes the dash serial number and the version of the software installed.

On Mk.II Dashes, the readings will be similar to these:

Dash Serial Number	1041
Software Version	3.70 F3

You should make a note of the version number displayed on your dash and have it ready if you ever need technical support.

Real-time mode



After powering up, the dash goes into Real-time mode Page 1 and remains there until the car is driven.

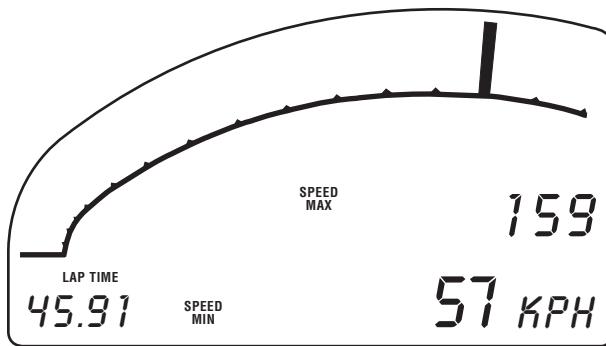
As the name suggests, Real-time mode is used to show the readings of the sensors on the car in real time (i.e. continuously), as they happen.

The word *Page* is used to describe a single screen display on the dash. All Pages in Real-time mode include the RPM bar graph, red line marker and max-rev marker in addition to the particular information listed in the following table.

Real-time Pages

Page 1	Lap time (Beacon kit required) Max. Speed Min. Speed
Page 2	Lap time Lap number Current speed
Page 3	RPM (digital)
Page 4	Current Speed Latched speed
Page 5	Water temperature
Page 6	Oil temperature
Page 7	Oil pressure
Page 8	Fuel pressure
Page 9	User 1
Page 10	User 2
Page 11	Box (dash) temperature
Page 12	Battery voltage

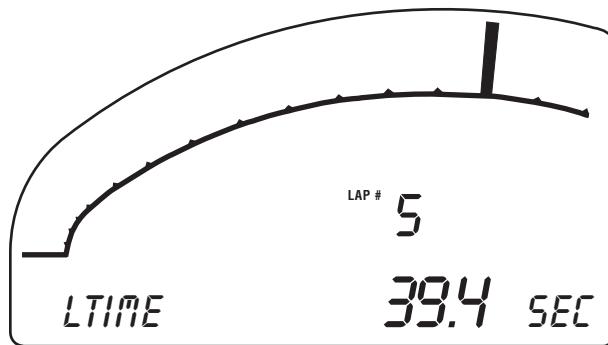
Race mode



Race mode has the same display Pages as Real-time mode, but differs in that the dash is also logging data.

The dash enters Race mode when the car exceeds its minimum outing speed, for example, 40 mph. Once the car starts moving, it automatically switches to Page 1 and starts displaying maximum and minimum speeds.

Telltale mode



When you return to the pits after driving the car around the track, the dash detects that you have come to a stop.

Three seconds later, the dash switches to Telltale mode to show you the most important information about the outing you've just completed.

In Telltale mode, the lap number and lap time for the fastest lap (assuming a Beacon is being used) are displayed.

Telltale mode displays the following information for each lap:

- Lap time
- Max. RPM
- Max. Speed
- Max. Water temperature
- Max. Oil temperature
- Min. Oil pressure
- Min. Fuel pressure
- Max. User 1
- Max. User 2
- Min. Battery voltage
- Max. Box temperature.

At the Track

Initial checks

This section takes you through a typical day of using System 2.

If you have not used System 2 before, you may need to refer to the 'Configuring the dash' and 'Using the dash' sections.

Kit list

For a typical day using System 2,

If you have a Beacon kit, you will need:

- the Beacon transmitter and power lead,
- a 12V battery to run the Beacon transmitter.

If you use a printer, you will need:

- the printer,
- printer paper,
- a power lead or battery,
- the System 2 printer lead.

If you have the Club *Expert* PC software, you will need:

- your laptop computer, (with Club *Expert* installed)
- a recharger or a spare battery,
- the System 2 computer lead,
- some formatted floppy discs for backing up data.

In case of accident damage, we suggest you have:

- a basic toolkit (including crimping tool and System 2 insertion tool)
- some spare System 2 connectors,
- a spare wheel speed sensor,
- a spare temperature sensor,
- a spare pressure sensor.

Checklists

Before each outing, check that:

- the dash is powered up
- the dash has been reset
- the dash has been configured properly for the car
- the sensors are working properly (Click the CHANNEL button to check each sensor value, e.g. car battery voltage or steering position)
- the wheel speed sensor is adjusted correctly (spin the wheel)
- the sensor wiring has not been damaged, if you've been working on the car.

If you have a Beacon kit, check that:

- the Beacon transmitter is wired up and working (check the front light on the transmitter)
- the transmitter and detector are set to the same channel
- the Beacon detector is working (wave the transmitter in front of it and make sure the lap times change)
- the transmitter is placed on the pit wall at the same height as the detector
- the battery is fully charged
- you've remembered to pick up the transmitter after the race!

NOTE: The lap times are stored in the dash, not in the Beacon transmitter. This means that all the cars in your team can use the same Beacon channel with a single transmitter.

Each time you visit a circuit, try to place the transmitter at exactly the same place on the pit wall. This will ensure that graphs produced by the Club Expert PC software from different visits to the same track align.

A master Beacon transmitter is installed at major tracks in the UK. The beacon transmitter is set to channel 0. To use this transmitter you must set your beacon detector to channel 0. You do not then need to use your own beacon transmitter.

If you use a printer, check that:

- the printer is turned on
- paper has been loaded
- the System 2 printer lead has been plugged in
- the dash has been properly configured for your particular printer
- the printer has been properly configured for use with System 2 (see the 'Configuring the dash' section).

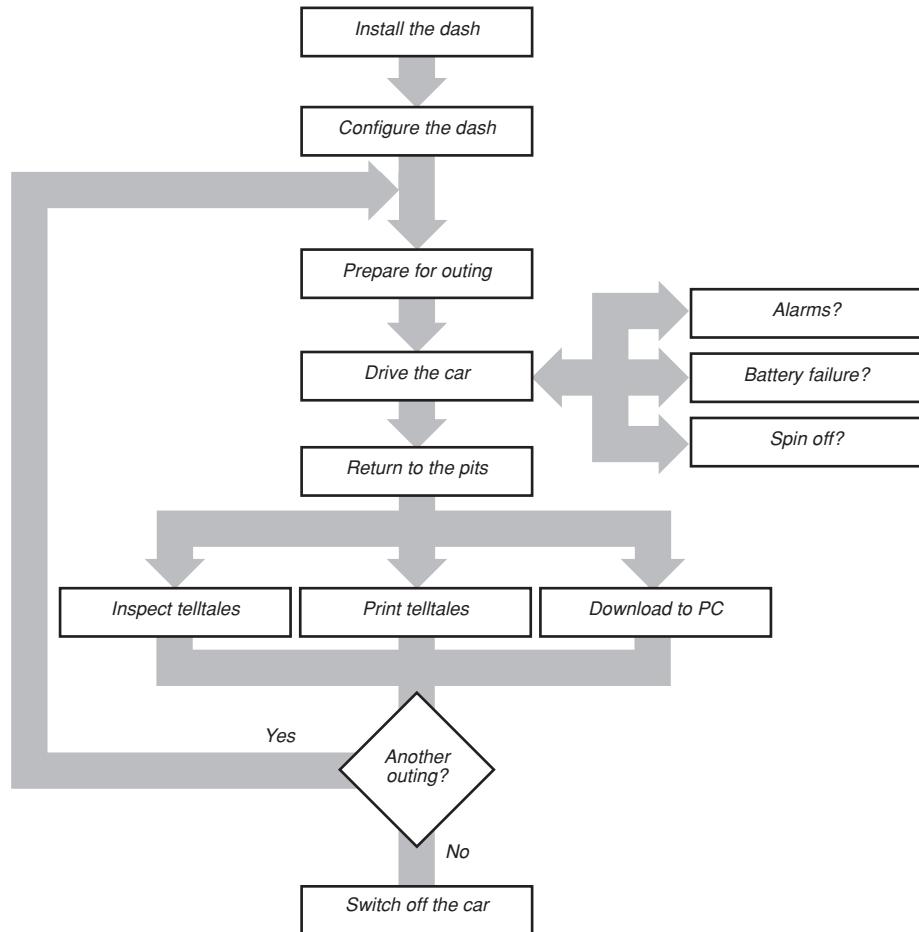
If you have the Club *Expert PC* software

- Before you leave for the track, make sure that the laptop has been fully recharged. Most monochrome laptops can run on batteries for about two hours.
- If this is your first visit to a particular track, run the software and enter the track name.
- Remember to enter the driver and outing details once you have downloaded data from an outing.
- Wait for the dash to power up (about three seconds) before plugging in the computer lead.
- If you do not want to download a certain outing to the computer, *reset the dash* to avoid it filling up with data.
- The data you get from the car may be valuable and you should back-up the outings onto floppy discs on a regular basis (see the Club *Expert PC* Software Guide on the subject of archiving data).

A typical day...

Once you have completed the check lists, you are now ready to go.

The diagram below shows a typical day's use of System 2. (The unit will normally have been correctly installed and configured for your car.)



Preparing for an outing

Powering up the dash

Turn on the master switch (and ignition switch, if necessary) to power up the dash. The dash changes from Power up mode to Real-time mode.

Check configuration

The first time you use the dash, check that it is correctly configured (see the 'Configuring the dash' section).

Warming up the car

1. Press the starter button to fire up the engine.

Use the dash to monitor temperatures and pressures whilst you warm the car up in the pits.

2. Click the **CHANNEL** button to cycle through the different Pages.

(The dash does not log data at this point.)

Resetting the dash

If you want to log data, make sure the dash has been reset the first time you go out on a new track.

1. Double Click the **MODE/LAP** button.
2. Click the **CHANNEL** button to erase data.

NOTE: If you use a laptop computer, the dash is reset automatically whenever you download logged data.

Driving the car

The car is now ready to drive.

1. Press and Hold the **CHANNEL** button to switch to Page 1.

As you leave the pits and pass the outing speed, the dash starts logging. Page 1 shows:

- the RPM,
- the maximum straight line speed,
- the minimum cornering speed, and
- lap times.

2. Click the **CHANNEL** button to display Page 2.

Page 2 shows:

- the RPM,
- the lap number
- the lap time.

To return to Page 1 at any time:

3. Press and Hold the **CHANNEL** button.

The RPM bar graph

The RPM bar graph appears on all of the Pages, and has some useful features:

- An adjustable “red line” marker. Some drivers use this as a gear-change indicator.
- When the RPM exceeds the red line, both the bar graph and the over-rev light flash.
- A telltale marker shows the highest RPM reached. This can be cleared by Clicking the **MODE/LAP** button while the car is being driven.

Lap Times

As you drive past the Beacon transmitter on the pit wall, the time for your last lap appears on the display. Page 2 also shows a lap count.

Latched Speed

With the current road speed displayed on Page 4, Click the **MODE/LAP** button. This latches the current speed.

NOTE: External buttons can be fitted to the steering wheel as an option.

Spinning off

If you spin off the track and restart quickly, System 2 continues to log data.

If you spin off and stop for more than three seconds, the display switches into Telltale mode (the system cannot distinguish between a pit stop and a spin). When you get back onto the track, the display switches back into Race mode automatically and adds data to that already logged.

Alarms

An important feature of System 2 is its ability to warn you if there is anything wrong with the parameters it is monitoring (e.g. loss of oil pressure).

The thresholds at which the alarms go off are set in Configuration mode.

If an alarm condition is detected, the Alarm light goes on and a message appears on the screen. If the alarm comes on, and stays on (e.g. there is an oil leak):

1. Click *either* button to reset the alarm.

The alarm thresholds are adjusted for the remainder of the outing, to prevent them from re-triggering immediately. If the problem (e.g. low fuel pressure) is temporary, the alarm will reset itself and the threshold will not be adjusted.

NOTE: After a manual reset, alarm thresholds are reset to their original value only when the dash is reset.

Battery Failure

System 2 requires a minimum battery voltage (9V) in order to operate. If the car battery delivers less than this, the dash will anticipate a power failure and will save the data logged so far.

The Battery Alarm will alert you when the battery is running low. From then on (until the car stops) the dash will display information as usual but will not attempt to log it.

Returning to the pits

*NOTE: Each time you come into the pits **YOU MUST ALLOW THE CAR TO STOP FOR 3 SECONDS** before killing the power to the dash – otherwise data will not be recorded.*

On dash versions 3.49 and above, the Alarm light flashes twice when it is safe to switch off the dash.

Inspecting telltales

When you stop, and have the dash powered up, the lap number and time for the fastest lap are displayed.

NOTE: Depending on the way the dash is configured, you may have to Press and Hold the [MODE/LAP] button to manually select Telltale mode.

1. Click the [CHANNEL] button.

This cycles through the following telltales for the fastest lap:

- Lap time
- Max. RPM
- Max. Speed
- Max. Water temperature
- Max. Oil temperature
- Min. Oil pressure
- Min. Fuel pressure
- Min. Battery voltage
- Max. User 1
- Max. User 2
- Max. dash temperature

-
2. Click the [MODE/LAP] button to change the lap.

This cycles through the telltales (maximum and minimum values) for each lap, and for the outing as a whole, in the following sequence:

- the Out lap
 - Lap #1, lap #2, lap #3...
 - the In lap
 - the outing (except that no lap time is given for the outing as a whole).
3. Press and Hold the [CHANNEL] button to select the outing values.

Printing telltales directly from the dash

1. Make sure your printer is powered up and is loaded with sufficient paper.
2. If the dash is in Real-time mode, Press and Hold the [MODE/LAP] button to return to Telltale mode.
3. Plug the System 2 printer cable into the Communication port on the car.

After a short delay, the data is printed out. Refer to the section 'Using the System 2' for details on printing.

Downloading to a laptop PC

To download data from the dash to a laptop computer:

1. Have your laptop powered-up and running the Club *Expert* PC software.
2. Select the track from the existing list, or enter the name for a new track.
3. Plug the computer lead into the 9-pin serial port on the back of the laptop.
4. Plug the other end of the computer lead into the communication port on the car.

A bar graph is displayed on the bottom of the computer screen to indicate the proportion of data transferred so far. DO NOT REMOVE THE LEAD from the car until the bar graph has completely filled up.

You can now exit the program and turn off the laptop, or analyse the data further. Because you have downloaded the data, the dash resets itself for the next outing.

See the Club *Expert* PC Software Guide for details of how to use the analysis software.

Switching off the car

Once the car has come into the pits and the dash has stored its data (i.e. when the Alarm LED flashes), it is safe to turn off the dash.

Data from the outing is retained in the dash by a small internal battery and may be printed or downloaded to a computer at any time before the next outing.

A note on Outings

In general, an *Outing* is defined as the time a car spends between leaving the pits and returning to the pits at the end of the race or practice.

To avoid the dash being reset if your car spins off and stops on the track, data continues to be logged until either:

- the dash fills up with data;
- the data is downloaded to a laptop PC;
- the data is printed out; or
- the dash is manually reset.

Data logging is triggered by exceeding a preset road speed (for example, 40 mph). This avoids filling up the dash with unwanted data before you start the race or practice laps.

Configuring the dash

Settable parameters

This section describes in detail how to configure the dash. You will need to do this when you first install System 2. You may also wish to adjust alarm thresholds when you are more familiar with the System.

To allow System 2 to be used on a wide range of cars, there are a number of parameters that can be adjusted to your particular requirements.

Some of these parameters only need to be set once, when System 2 is installed. However, you may wish to adjust parameters such as the RPM over-rev light or battery voltage alarm level more frequently.

Configuration

The parameters, their range and defaults are listed in the following table.

<i>Setup</i>	<i>Min.</i>	<i>Max.</i>	<i>Default</i>
Alarms			
Oil pressure (psi or TURB1)	0	200	20
Oil temperature (°C)	10	150	105
Water temperature (°C)	10	150	105
Fuel pressure (psi or TURB2)	0	200	20
User 1	10	999	105
User 2	10	999	105
Battery voltage (volts)	9	20	10.5

<i>Setup</i>	<i>Min./Options</i>	<i>Max.</i>	<i>Default</i>
RPM			
Red line (rpm)	0	20,000	6,500
Pulse (4 stroke)	1	16	4
Max. scale (rpm)	3,500	19,500	7,500
Pulse type	A/B/C/D		A
Flashing telltale	Yes/No		Yes
Spike filter	Off/3/7		Off
Over rev light duration	0.01	2.0	0.01
Speed			
Tyre diameter (mm)	30	999	535
Triggers (per rev)	1	100	2
Outing start speed	0,2,20,40,80,112		112
Units			
Speed	KPH/MPH		KPH
Oil/Water temperature	°C/°F		°C
Fuel pressure	psi/KGF/bar/Tbar		psi
Oil pressure	psi/KGF/bar/Tbar		psi
User 1	°C/°F/VLT/°CT		°C
User 2	°C/°F/VLT/°CT		°C
Tyre diameter	mm/inches		mm
Name			
User 1	5 character alphanumeric		USER1
User 2	5 character alphanumeric		USER2

<i>Setup</i>	<i>Options</i>	<i>Default</i>
Printer		
Printer type	Basic/Paintjet/Diconix/IBM	Basic
Beacon		
Beacon fitted	No/Yes	No
Mode	Fix/Run	Fix
Engine logbook		
Reset	Keep/Reset	
Keep		
Logging		
Rate	Fast/Slow	Fast
Accel	Yes/No	Yes
User 1	Yes/No	No
User 2	Yes/No	No
Oil pressure (or Turbo 1)	Yes/No	No
Fuel pressure (or Turbo 2)	Yes/No	No
Water temperature	Yes/No	No
Oil temperature	Yes/No	No
Battery voltage	Yes/No	No
Outing type		
Outing Type	Auto/Manual/Rally	Auto

Configuration mode

The table below shows how Parameter values are organised in Configuration groups. The table on the facing page summarises the dash button operations for editing parameter values in Configuration mode.

<i>Configuration groups</i>		<i>Parameter values</i>
ALARMS		Oil pressure/ Oil temp./ Water temp./ Fuel pressure/ User 1/ User 2/ Battery
RPM		Redline/ Pulses/ Max. scale/ Pulse type/ Flashing telltale/ Filter/ Light
SPEED		Tyre diameter/ Triggers/ Outing speed
UNITS		Speed/ Temperature/ Fuel Pressure/ Oil Pressure/ User 1/ User 2/ Tyre diameter
NAMES		User 1/ User 2
PRINTER		Printer type
BEACON		Beacon fitted/ Mode
LOGBOOK		Reset
LOGGING		Rate/ Accelerometer/ User 1/ User 2/ Oil pressure/ Fuel pressure/ Water temp./ Oil temp./ Battery
OUTING		Type

NOTE: Repeat the steps for configuring parameter values as often as necessary before saving the current settings. We suggest you configure the Unit parameters first.

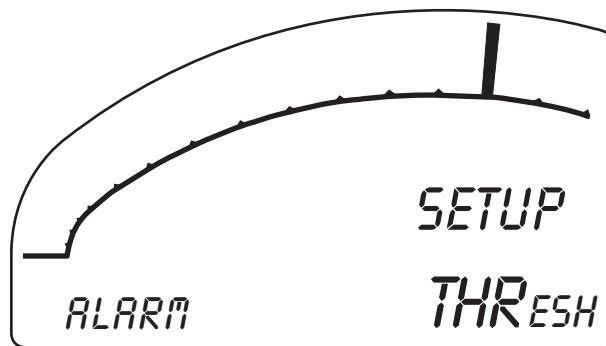
WARNING: Changing configurations may cause data to be erased. Only enter Configuration mode after you have inspected or downloaded data from any previous outings.

<i>To do this:</i>	<i>Do this:</i>
<i>Enter Configuration mode:</i>	  <i>Press and Hold CHANNEL and LAP/MODE buttons together</i>
<i>Step through Configuration groups:</i>	  <i>Click CHANNEL</i>
<i>Inspect or alter a Configuration group:</i>	  <i>Press and Hold CHANNEL</i>
<i>Step through Parameter values:</i>	  <i>Click CHANNEL</i>
<i>Increment values:</i>	  <i>Click LAP/MODE</i>
<i>Auto-adjust values:</i>	  <i>Press and Hold LAP/MODE</i>
<i>Save the current settings within each Configuration group:</i>	  <i>Press and Hold CHANNEL</i>
<i>Save all current settings:</i>	  <i>Press and Hold CHANNEL and LAP/MODE buttons together</i>

Entering Configuration mode

The car must be powered up, stationary and in Real-time mode. You cannot access Configuration mode from Telltale mode.

1. Press and Hold the **CHANNEL** and **MODE/LAP** buttons for two seconds.



The dash flashes **SETUP** on the display and shows the first Configuration Group, Alarms.

Selecting a Group

1. Click the **CHANNEL** button to cycle through the Configuration Groups.
Stop on the one you want to view or change (alarm thresholds, RPM, speed, etc.).
2. Press and Hold the **CHANNEL** button.

Selecting a Parameter

1. Click the **CHANNEL** button to cycle through the parameters until you reach the one required.

You can either Alter or Inspect a parameter:

Altering a parameter

There are two ways to change the value of a parameter once you have selected it: Step mode and Auto-adjust mode.

Step mode

Step mode is most suited to values that have a small range, or only switch from Yes to No.

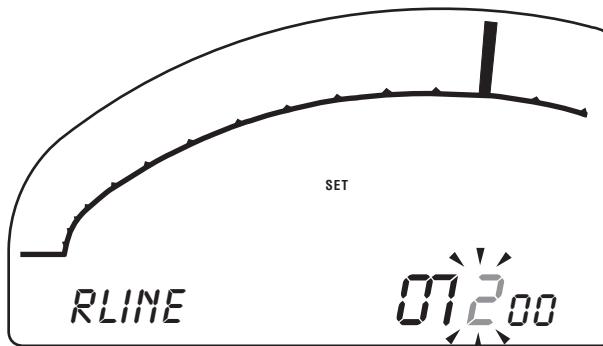
1. Click the **[MODE/LAP]** button to increment the value of a parameter one step at a time.

Auto-adjust mode

This mode is most suited to values that have a wide range of values, such as temperatures, tyre sizes or user channel name.

1. First Press and Hold the **[MODE/LAP]** button.

If auto-adjust is available for a parameter, the digits will start to flash between '0' and '9'.



2. Click the **[MODE/LAP]** button to freeze each digit at its correct value, starting with the left-most digit.

Once all the digits have been frozen, auto-adjust mode ends automatically.

NOTE: In Auto-adjust mode, if you try to set a value below the minimum permitted value, it will be set at the minimum. Similarly, any value set above the maximum value will be set to the maximum permitted value.

To Inspect or Change other parameters in the Group

1. Click the **CHANNEL** button

To Return to the Configuration Groups

1. Press and Hold the **CHANNEL** button to return to the Configuration Groups.

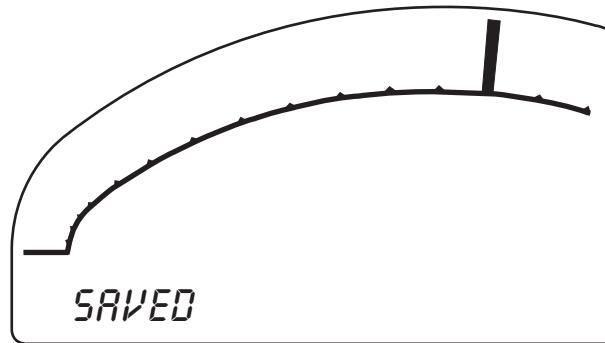
You can then select another Group of parameters or leave Configuration mode.

To Leave Configuration mode

To save the parameters and exit from Configuration mode:

1. Return to the main Configuration Groups.
2. Press and Hold the **CHANNEL** and **MODE/LAP** buttons for two seconds.

The dash momentarily displays the word **SAVED**.



To Exit without saving changes

If you make a mistake or change your mind, you can restore the previously stored settings by switching off the dash (e.g. with the master switch) before exiting Configuration mode.

Alarms

You must set the values for the following parameters as the *highest value* allowable before an alarm is triggered:

- Oil temperature
- Water temperature
- User 1
- User 2

You must set the values for the following parameters as the *lowest value* allowable before an alarm is triggered:

- Oil pressure (or Turbo 1)
- Fuel pressure (or Turbo 2)
- Battery voltage

NOTE: If either pressure channel is configured as a turbo channel, the alarm LED can be set to come on when the turbo drops below a given value.

RPM

Detailed instructions on setting up the RPM are included in the Installation Notes.

Red line

The RPM for the red line marker on the display. This should be less than the SCALE setting (see below).

Pulse

The number of ignition pulses per TWO revolutions of the engine.

Max. Scale

This parameter is generally fixed by the markings on the display. However, it can be adjusted in steps of 1000 RPM by using adhesive overlays.

Pulse type

The Pulse type can take values A, B, C or D. Use type D with the Pi RPM box. If you are using a signal directly from an ECM (Engine Control Module), you may need to select a different type. If you are having problems with the RPM, check the setting on the RPM Box as well (see the 'Installation Notes' section).

Flashing telltale

Switches the flashing marker on the bar graph On or Off.

Spike Filter

Although normally unnecessary, the dash can filter out spikes on tacho signals from ignition systems.

Overrev Light Duration

Sets how long the over-rev light stays on.

Speed

Tyre diameter

Sets the tyre diameter on which the wheel speed trigger is mounted (in millimetres or inches).

NOTE: Take special care in measuring the tyre diameter since this setting affects the accuracy of all speed readings.

Triggers

Sets the number of speed triggers that are fitted on the wheel.

Outing start speed

Sets the speed that must be exceeded before logging starts. This will vary according to your car, but should be greater than the speed reached when you drive around the pits or garage areas.

Wheel trigger indicator

(Dash version 3.49 or higher) When on Speed settings, the alarm light will flash when the wheel speed sensor detects its trigger. This feature will help you check the setting of the sensor.

Units

The following parameters may be measured in various units. Select the ones you prefer when configuring the dash for the first time.

Speed

Set the Speed units to either miles per hour (mph) or kilometres per hour (kph).

Oil/Water Temperature

Set the Temperature units to either Celsius (°C) or Fahrenheit (°F).

Fuel Pressure

Set the Pressure units to either pounds per square inch (psi), 100,000N/m² (bar), kilogram force (kgf), or Tbar (bar) for turbo sensors (0 to 2.5 bar).

Oil Pressure

Set the Pressure units to either pounds per square inch (psi), 100,000N/m² (bar), kilogram force (kgf), or Tbar (bar) for turbo sensors (0 to 2.5 bar).

User 1

Set the User 1 channel to measure either temperature (C° or °F), voltage (VLT), or thermocouple temperature (°CT).

User 2

Set the User 2 channel to measure either temperature (C° or °F), voltage (VLT), or thermocouple temperature (°CT).

Tyre diameter

Set the tyre diameter units to either millimetres (mm) or inches (inches).

Name

You can assign your own names to channels User 1 and User 2. Using Auto-adjust mode, you can set each digit to be A–Z, 0–9 or blank.

Printer

Printer type

If you intend to print data directly from the dash, you will require a printer with a serial interface. Set the Printer type to be the same as the make or emulation mode of the printer.

Beacon

Beacon fitted

If you have the Beacon kit installed, set this option to YES to detect Beacon pulses.

Mode

The lap timer can be configured to show the lap time for the previous lap (Fix), or as a running timer (Run).

Engine Logbook

The Logbook records the history of an engine from the time it is reset. This data is only available by using the Club *Expert* PC software. If you change the engine in your car, select Reset with the **[MODE/LAP]** button.

Graph logging

Rate

This selects a fast or slow logging rate for the speed and RPM data. Fast logging gives better resolution on the Club *Expert* PC software; slow logging doubles the logging time.

Rate	Samples per second	
	Speed	RPM
Fast	10	20
Slow	5	10

NOTE: Other parameters (i.e. Oil pressure) are sampled at the same rate as speed (e.g. 5 or 10 samples per second).

Accel

Once you have made a map of a track with the Club *Expert* PC software there is no longer any need to log lateral acceleration (cornering g-force), unless you are using the Cornering Analysis Program (CAP). If are using CAP you must log Accel all the time.

To increase logging time, you can stop the dash from logging data from its internal accelerometer.

Acceleration	Logging time (minutes)	
	Fast	Slow
Yes	42	84
No	52	104

Graph Logging

When used with Club *Expert plus*, you have the option of being able to produce graphs for any of the following channels:

- User 1
- User 2
- Oil pressure (or Turbo 1)
- Fuel pressure (or Turbo 2)
- Water temperature
- Oil temperature
- Battery voltage

Outing type

Type

- On Manual setting, the dash is reset as normal, e.g. when a printer or PC is plugged into the computer, or when the dash is manually reset.
Use this mode if you are using the Club *Expert* software on a regular basis.
- On Auto setting, the dash is also reset at the beginning of the day when the engine temperatures are cold. This saves you from having to manually reset the dash and will prevent the MAX. indicator flashing when the dash is full.
- On the Rally setting, the dash behaves as in Auto, but also:
 - the dash does not automatically enter Telltale mode when the car stops;
 - the start logging criteria change to outing speed and 20% of RPM redline, as opposed to 40%;
 - to stop logging, the dash must see zero speed for 10 seconds, as opposed to 3 seconds.

Using System 2

Real-time mode

This section gives you step-by-step instructions on how to use the dash. It can be used for reference once you have understood the concepts described in the sections 'Overview' and 'At the Track'.

Real-time mode displays the same information as Race mode, except that the data is not stored. Once you exceed the outing speed, the system automatically switches to Race mode and begins logging data.

CHANNEL button

The **CHANNEL** button is used to move through the different Pages to display the values recorded by the various sensors.

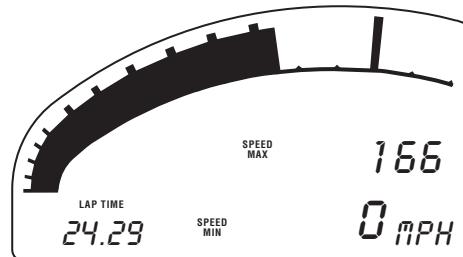
- Click the **CHANNEL** button to cycle through the Pages.
- Press and Hold the **CHANNEL** button to return to Page 1.

MODE/LAP button

- Press and Hold the **MODE/LAP** button to switch to Telltale mode. (Note: this only works after the car has been driven, and is stationary.)
- Double Click the **MODE/LAP** button for Reset options.

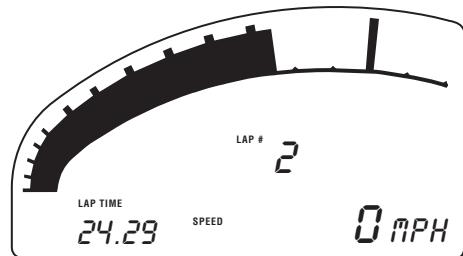
The 12 Real-time mode Pages display data as follows:

Page 1: Lap time, max. and min. speed



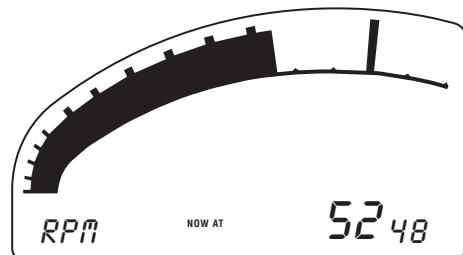
(○) (●) Click CHANNEL

Page 2: Lap time, lap number and current speed



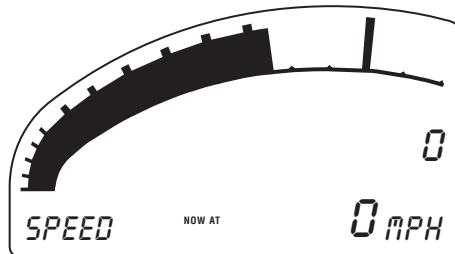
(○) (●) Click CHANNEL

Page 3: RPM



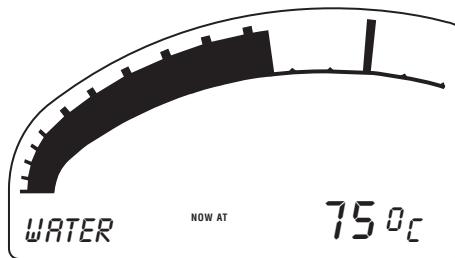
(○) (●) Click CHANNEL

Page 4: Speed



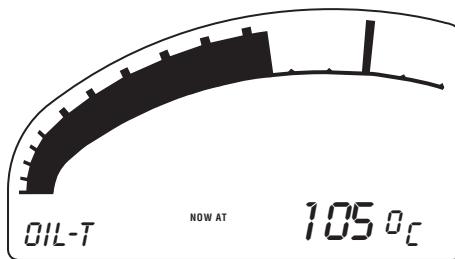
(○) (●) Click CHANNEL

Page 5: Water Temp



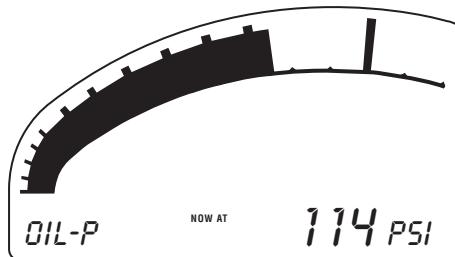
(○) (●) Click CHANNEL

Page 6: Oil Temp



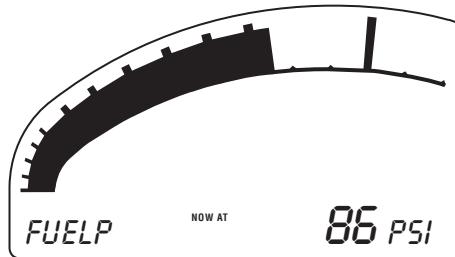
(○) (●) Click CHANNEL

Page 7: Oil Pressure



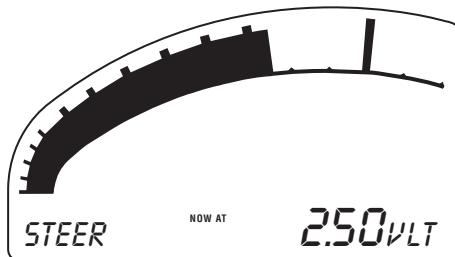
○ ● Click CHANNEL

Page 8: Fuel Pressure



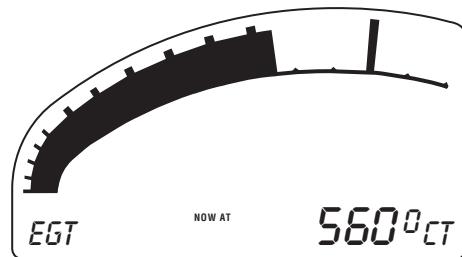
○ ● Click CHANNEL

Page 9: User 1 (Steer)



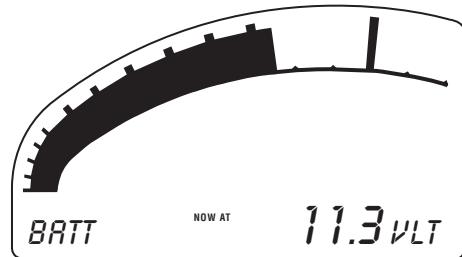
○ ● Click CHANNEL

Page 10: User 2 (EGT)



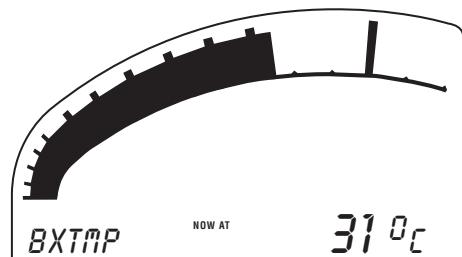
○ ● Click CHANNEL

Page 11: Battery Voltage



○ ● Click CHANNEL

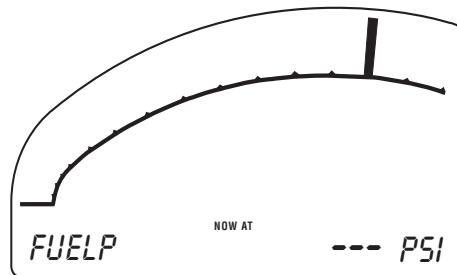
Page 12: Box Temperature



Null Value

If a sensor has not been connected, a null value is displayed. In the example below, the fuel pressure sensor is not connected.

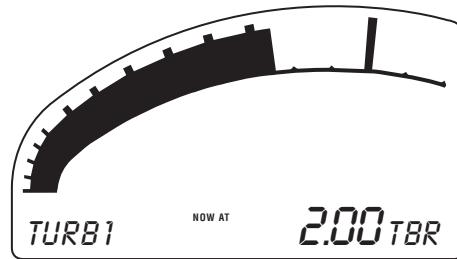
No Fuel pressure



Turbo

If the oil or fuel pressure channels are configured for a turbo sensor they are displayed as follows:

Turbo



Race mode

Race mode is similar to Real-time mode except that data logging takes place during Race mode (this is triggered by driving the car above its outing speed).

The CHANNEL button

- Click the [CHANNEL] button to cycle through the Pages.
- Press and Hold the [CHANNEL] button to return to Page 1.

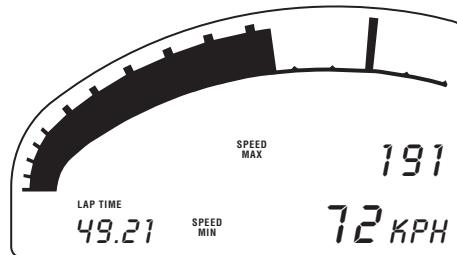
The MODE/LAP button

- Click the [MODE/LAP] button to reset the RPM telltale.
- Click the [MODE/LAP] button to latch the current road speed (when on Page 4).

Alarms

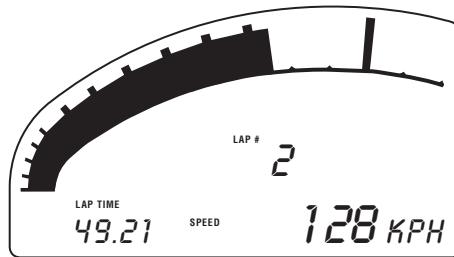
- Click the [MODE/LAP] or [CHANNEL] buttons to clear an Alarm signal.

Page 1: Lap time, max. and min. speed



Click [CHANNEL]

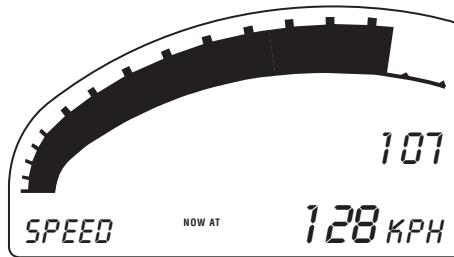
Page 2: Lap time, lap number and current speed



 Click CHANNEL

Page 4: Speed

Clicking the MODE/LAP button on the Speed Page latches the current road speed.



 Click MODE/LAP

Alarms

System 2 has been specially designed to trigger an alarm if any of the following parameters are exceeded:

- Max. Water temperature
- Max. Oil temperature
- Min. Oil or turbo pressure
- Min. Fuel or turbo pressure
- Max. User 1 or User 2 values
- Min. Battery voltage

After an Alarm has been generated, the thresholds are adjusted (until the dash has been reset), preventing alarms from retriggering after a spin:

- Temperature +5°C
- Pressures –5 psi
- Voltage –0.5 volts

Alarm prevention

To prevent alarms being set off unnecessarily, they are only triggered when:

- the RPM goes above 40% of the red line (i.e. the engine attains 3600 RPM for a car with a red line set at 9000 RPM), or
- the car has been moving for more than 30 seconds.

Adjusting Alarms

You can adjust the Alarm thresholds when the dash is in Configuration mode; see the ‘Configuring the dash’ section.

User channels

User channels are alarmed for use with temperature or thermocouple sensors. If you are using voltage readings for steering or throttle position, you should set alarm thresholds in excess of 5.5 volts to prevent the alarms being triggered.

Telltale mode

The dash automatically enters Telltale mode after the car has been driven and has come to a standstill for more than three seconds.

NOTE: Dash version 3.33 and below also require zero RPM before entering Telltale mode automatically. On these dashes you can select Telltale mode with the [MODE/LAP] button while the engine is still running.

The CHANNEL button

- Click the [CHANNEL] button to cycle through max. and min. values for the current lap or outing.
- Press and hold the [CHANNEL] button to see the telltales for the whole outing.

The MODE/LAP button

- Click the [MODE/LAP] button to move to the next lap or outing.
- Press and hold the [MODE/LAP] button to switch between Real-time and Telltale mode.
- Double Click the [MODE/LAP] button for Reset options.

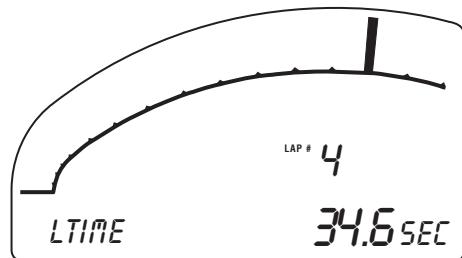
*NOTE: The first lap driven in an outing is always called the **Out** lap. The last lap driven in an outing is always called the **In** lap.*

Version 3.49 and above:

*If a car enters and leaves the pits in the middle of an outing, the entry lap is called the **Pit** lap and the exit lap is the **Start** lap.*

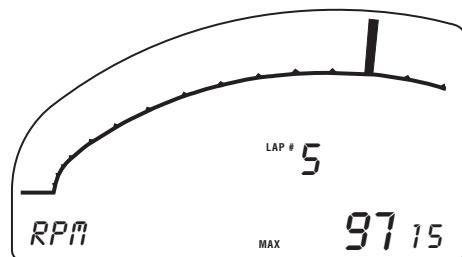
Lap Telltales

Default Page (Fastest lap time)



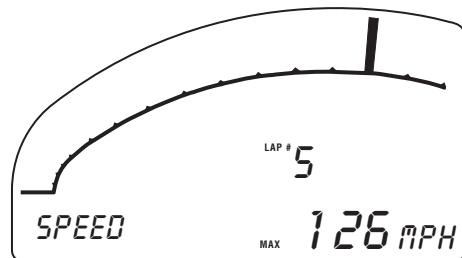
○ ● Click CHANNEL

Max. RPM



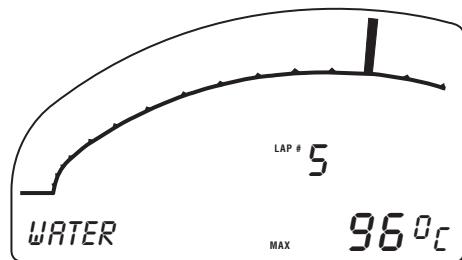
○ ● Click CHANNEL

Max. Speed



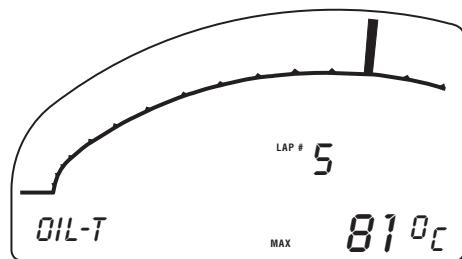
○ ● Click CHANNEL

Max. Water temperature



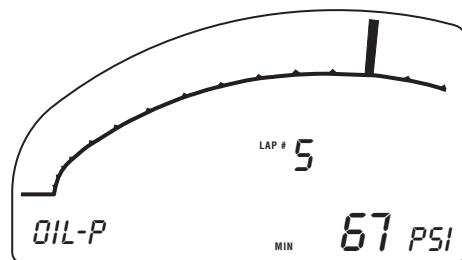
○ ● Click CHANNEL

Max. Oil temperature



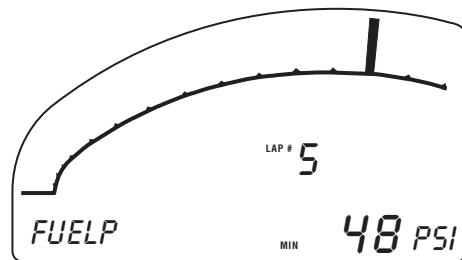
○ ● Click CHANNEL

Min. Oil pressure



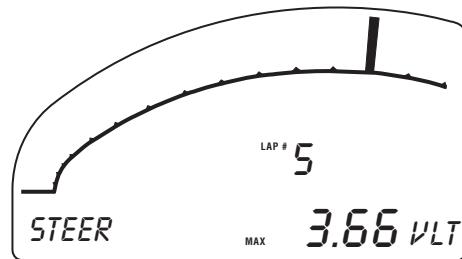
○ ● Click CHANNEL

Min. Fuel pressure

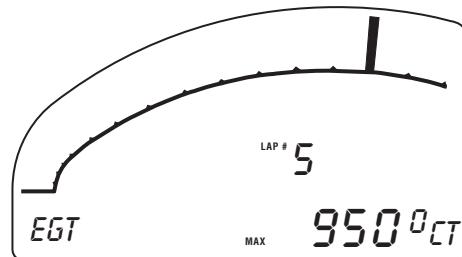


○ ● Click CHANNEL

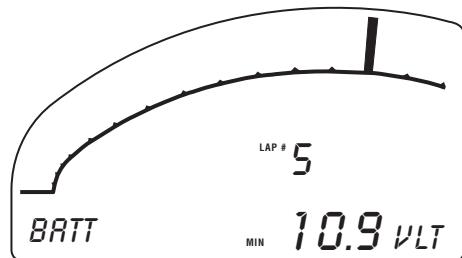
Max. User 1 value (Steering)



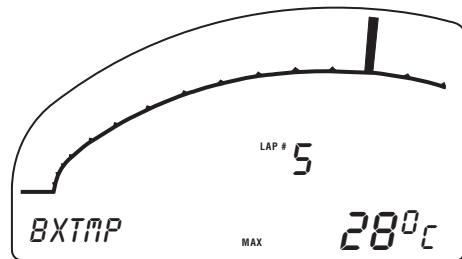
○ ● Click CHANNEL

Max. User 2 value (EGT)

○ ● Click CHANNEL

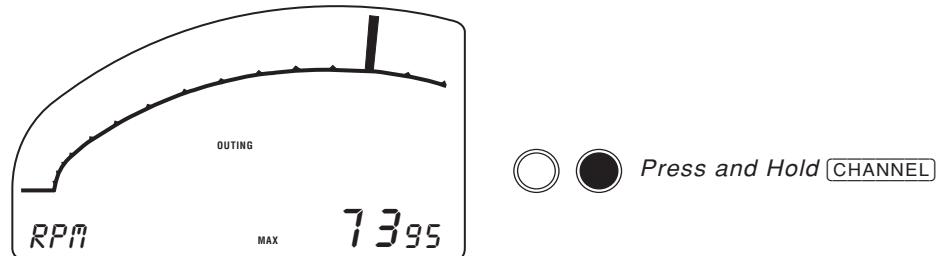
Min. Battery voltage

○ ● Click CHANNEL

Max. Box temperature

Outing Telltales

On the Outing Pages, maximum and minimum values are shown for the whole outing.



Notes

- Times are not shown for Out or In laps, since they are not generally useful.
- A lap time cannot be shown for an Outing, only for a given lap.
- If a Beacon is not used, maximum and minimum values are shown for the whole outing and not for each lap.

Printing Reports

Telltale values stored in the dash can be printed out for reference purposes.

All printouts show the following values for the outing:

- max. RPM
- max. Speed
- max. Oil temperature
- max. Water temperature
- min. Oil pressure
- min. Fuel pressure
- max. User 1 or User 2 values
- min. Battery voltage
- max. Box temperature

If a Beacon was used, the printout also includes:

- an Engine Report with RPM and Speed values for each lap,
- a Pressure Report with Oil and Fuel pressures for each lap,
- a Temperature Report with Water and Oil temperatures for each lap, and
- a Miscellaneous Report with Battery voltage and Box temperature for each lap.

Getting a printout

Before you drive the car:

1. Make sure that the dash is configured for your printer.

This will vary according to the type of printer you have. Some printers require that you select 'Emulation Mode' (see below).

2. Turn the printer on and feed the paper in.
3. Plug the 25-way connector of the System 2 printer lead into the printer.

When the car has been driven and returns to the pits:

1. Plug the 5-way connector of the System 2 printer lead into the car's communication port.

When the dash detects the printer is connected, it starts printing out the Telltale report.

Printing out the Telltale report resets the dash. To get another copy of the printout:

1. Retrieve the data in the dash.

This is done by using the manual reset routine and selecting *ND*.

2. Select Telltale Mode.
3. Press and Hold the **[MODELAP]** and **[CHANNEL]** buttons at the same time for two seconds.

Notes on selecting a printer

Due to the wide variety of printers on the market, System 2 has been designed for use with four popular printer types:

- Basic = Epson FX-80
- Paintjet = HP Paintjet
- Diconix = Kodak Diconix
- IBM = IBM Proprietary

Select the printer you are using while in Configuration mode (see the 'Configuring the dash' section).

Printing directly from the dash

The dash has a serial printer interface and is supplied with a 25-way D-type printer lead. If you intend to print directly from the dash, you will need a printer with a serial interface.

A Kodak Diconix printer (with serial interface) provides a cost effective and portable method of getting Telltale reports at the track.

Dash and Club *Expert PC* software Printing

If you use the Club *Expert PC* software, you will not need to print directly from the dash. If you wish to print from either the dash or your computer, you will need a printer with a serial interface (e.g. HP Paintjet). However, printing from the computer using a serial interface may be much slower than the usual parallel interface.

Emulation Modes

Most printers (e.g. Panasonic) can ‘emulate’ other printers. Any printer that can emulate the Epson FX-80 or IBM Proprinter can be used with System 2. If you do not have one of the printers supported by System 2, consult your printer manual.

NOTE: System 2 dash kits are not supplied with a printer lead as standard. For information on accessories, please contact your Pi representative.

Outings and resetting the dash

Outings

In general, an outing is defined as the time a car spends between leaving the pits and returning at the end of the race or practice.

Starting an Outing

Data logging is triggered by exceeding a preset minimum Outing Speed, for example, 40 mph. This prevents the dash from filling up with unnecessary data before you start the race or practice laps.

The minimum Outing Speed can be changed when the dash is in Configuration mode (see the ‘Configuring the dash’ section).

Ending an Outing

Normally, an outing is considered to end when the car comes into the pits and is stationary for three seconds or more.

At this point, the Alarm light flashes (dash versions 3.49 or higher) and the dash switches to Telltale mode. However, to avoid the dash being reset – and data lost – if your car spins off and stops on the track, data continues to be logged until any of the following takes place:

- the dash fills up with data;
- the data is downloaded to a PC;
- the data is printed out; or
- the dash is manually reset.

WARNING: Do not switch off the dash until the car has been stationary for more than three seconds (or data will be lost)!

Maximum Logging Time

The dash has enough memory to log data for a total of 42 minutes. Over this period, the high frequency logging rates are:

- RPM : 20 times a second
- Speed : 10 times a second

The other parameters are also logged ten times a second.

By reducing the logging rates, the maximum logging time can be increased (see the 'Configuring the Dash' section).

When the dash is full

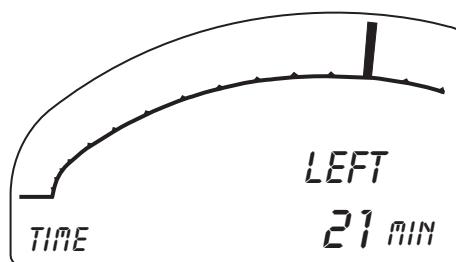
When the dash fills up, the word *MAX* flashes in the centre of the display. When this happens, the dash stops logging data. However, alarms may still be triggered and lap times and sensor readings are still displayed.

Inspecting/Resetting the logging memory

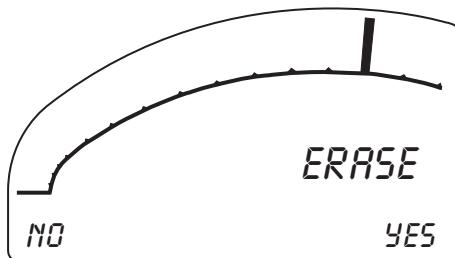
To check how much logging time is left in the dash when the car is stationary:

1. Double Click the **MODE/LAP** button.

The time left is then displayed.



A few moments later, the display gives you the option of erasing the logging memory:



- Click the **CHANNEL** button **YES** to erase the data in the dash.
- Click the **MODE/LAP** button **NO**, or wait for 10 seconds, to leave the data in the dash.

The Next Outing

If you chose not to erase the logging memory, new data will be added to the data already collected.

If you continue to do this – and do not download data to a printer or computer – the dash will eventually fill up and be **unable to log any more data**.

Retrieving data

Even if the dash has been reset, it is still possible to print out data or download data to a laptop computer.

You can recall (“un-erase”) data at any time until the car leaves on the next outing by repeating the Reset procedure and choosing the **NO** option.

You may wish to do this if you have downloaded data to a computer (which resets the dash) but want to use the dash to inspect the data from the last outing.

Auto reset

Dash versions 3.49 or higher:

If case you forget to reset the dash at the start of a day's racing, the dash is programmed to reset itself if the engine is cold. To avoid accidental data loss, switch to Manual mode when using the Club *Expert PC* software (see the 'Configuring the Dash' section).

Data Loss

In certain situations, data may be "lost". The two most likely causes of data loss are:

Switching off the ignition when entering the Pit lane

The dash transfers data to its internal memory once the car comes to a standstill.

To make sure this doesn't happen while you are racing (during wheel-lock, for example), the dash waits a few seconds to confirm that you have actually stopped before storing data.

If you cut the power to the dash BEFORE the car has been stationary for three seconds, the data from the last outing will be lost.

Instantaneous power loss

If the battery suddenly fails while the car is moving, the dash may not have time to perform a controlled shutdown and data may be lost.

To minimise the risk of battery failure, make sure the car's battery is fully charged before you go out on the track.

New track/New map

Once the dash has stored its data, you can switch off the power on the car.

The backup battery in the dash saves the outing data until you download it to a PC or you reset the dash.

Because outing data is retained in the dash, it will still be there when you go to another track. If new data is then added to data from the previous track, it may be confusing when you use the PC analysis software. For example, you may create a map using the wrong data.

For this reason, it is good practice to manually reset the dash when you arrive at a new track.

Application Notes

These application notes explain how to configure and use your System 2 in a number of common applications. Installations can vary from car to car, so you should also ask your race car supplier how the system has been integrated into your particular vehicle. For further information please contact your Pi representative.

BMW M-System (1995)

Description

The M-System (e.g. System 2 dash) accepts engine data from the ECM via a serial data link, and uses standard inputs for monitoring wheel speed and lap times. Its fuel calculation feature can estimate the amount of fuel used, time to go and laps to go. The driver can move up or down through the display pages and the team can configure which channels are to be displayed and/or logged.

Constructor

BMW M GmbH
ZS-M-6
Daimlerstr. 19
D-8046 Garching bei München
GERMANY

Dash specification

Pi dash code ref.	30G-0019
Dash descriptor	BMW M
Version(s)	3.73 (Feb 95)
Backlighting	yes
Buttons	black
Logo	BMW M logo

PC Software

System 2	Version 1.13 or higher
Club Expert	Version 3.55 or higher

Channels

The following channels are available:

Parameter	Input	Page(s)	Logged
<i>Race Pages</i>			
RPM bar	ECM	1,2	–
Lap times	sensor	1,2	yes
Min speed	calculated	1	–
Max. speed	calculated	1	–
Speed	sensor	2	–
Lap number	sensor	2	yes
<i>Fuel Page</i>			
Time to go	calculated	3	–
Laps to go	calculated	3	–
Speed	sensor	3	–
<i>Monitor Pages</i>			
RPM	ECM	4	yes
Speed	sensor	5	yes
Water temp	ECM	6	option
Oil temp	ECM	7	option
Axle temp	ECM	8	option
Gear temp	ECM	9	option
Water press	ECM	10	option
Oil press	ECM	11	option
Fuel press	ECM	12	option
Fuel (left)	ECM	13	option
UPOT	ECM	14	option
Battery	dash	15	option
Dash temp	dash	16	–
Lateral g	dash	–	option

Configuration

The M-System has been preconfigured with the following settings:

<i>Parameter</i>	<i>Setting</i>
<i>Alarms</i>	
Water temp	95 °C
Oil temp	125 °C
Axle temp	140 °C
Gear temp	140 °C
Water press	1.40 bar
Oil press	2.00 bar
Fuel press	3.5 bar
Fuel level	10 litres
<i>RPM</i>	
Red line	8,400
Cylinders	4 (not accessible)
Max. scale	9,500
Type	C (not accessible)
<i>Speed</i>	
Wheel diameter	648 mm
Pulses	48
Start	40 kph
<i>Beacon</i>	
	Yes
<i>Outing</i>	
	Rally
<i>Fuel</i>	
Fuel full	512 litres
Period for average	1 lap

	<i>Parameter</i>	<i>Setting</i>
<i>Page list</i>		
	Fuel calc.	No
	RPM	No
	Speed	No
	Water temp	yes
	Oil temp	yes
	Axle temp	No
	Gear temp	No
	Water press	No
	Oil press	Yes
	Fuel press	No
	Fuel (left)	No
	UPOT	No
	Battery	No
	Dash temp	No
Pinouts	<i>Custom pinouts:</i>	
	<i>Pin</i>	<i>Description</i>
	13	ECM ground
	16	Page up +ve
	18	Page up -ve
	32	data from ECM
	33	data to ECM

Features

ECM interface

The M-System receives a serial data stream from the ECM on the car. The data is converted into the correct units by the dash and can be displayed or logged as required.

Page select

Within Configuration mode you can select which parameters to display, using the Page List.

Logging select

Within Configuration mode you can select which parameters to log using the .

Page Up/Down selection

An additional ‘page up’ button is supplied, to facilitate scrolling up or down through the display pages.

Fuel Calculations

Fuel left: The ECM provides a value for the amount of fuel left in the tank (in litres).

Time to go: The M-System calculates the rate of use of fuel over a fixed time period (or a lap if a Beacon is used). The M-System then divides the amount of fuel remaining by the rate of use to estimate a ‘time to go’.

Laps to Go: The M-System divides the ‘time to go’ by a lap time averaged over the last three laps to estimate the number of complete ‘laps to go’ based on the amount of fuel remaining in the tank. If the M-System is not configured to run with a Beacon the ‘Laps to go’ parameter is not displayed on the dash.

Fuel alarm: The low fuel alarm is only available if the fuel page is selected in the page list.

Fuel Page: If a Beacon is not used, the second race page (page 2) would only display real-time speed. To minimise the number of pages, the Fuel page (page 3) – if selected – replaces the second race page.

Special Issues

Wheel speed Selector Box

A wheel speed selector box has been developed to monitor two wheel speeds and select the highest measured speed. This is to overcome problems with one wheel lifting during severe cornering and providing erroneous speed readings to the M-System.

Rally Mode

We recommend that Rally mode is selected on the M-System to ensure accurate distance measurement.

ECM Shutdown

If the ECM is powered down while the M-System is running, information on the data link may be invalid. If unusual values for max. RPM are seen on the dash or with Club Expert PC software then the power down sequence may have been recorded by the dash. Contact your BMW M or Pi representative for further information.

Mazdaspeed Zytech ECM link

Description

This application provides an ECM link for taking engine data from a Zytech engine management system. The User channels are still available for use if required.

Constructor

Mazdaspeed Co. Ltd
5-23 Kachidoki, 6-chome
Chuo-ku
TOKYO 104
Japan

Dash Specification

Pi dash code ref.	30G-0017
Dash descriptor	MAZDA
Version(s)	3.70 (Nov 94)
Backlighting	Yes
Logo	Pi

Club *Expert* PC software

System 2 PC software	Version 1.13 or higher
Club <i>Expert</i> PC software	Version 3.55 or higher

Channels

The following channels are available:

Parameter	Input	Page(s)	Logged
<hr/>			
RPM bar	ECM	1,2	–
Lap times	sensor	1,2	yes
Min speed	calculated	1	–
Max. speed	calculated	1	–
Speed	sensor	2	yes
Lap number	sensor	2	yes
<hr/>			
<i>Monitor Pages</i>			
RPM	ECM	3	yes
Speed	sensor	4	yes
Fuel used	ECM	5	option
Throttle	ECM	6	option
Battery	ECM	7	option
Water temp	ECM	8	option
Air temp	ECM	9	–
Fuel temp	ECM	10	option
Oil temp	ECM	11	option
Fuel press	ECM	12	option
Oil press	ECM	13	option
Lambda	ECM	14	option
Diagnostics	ECM	15	option
User 1	sensor	16	option
User 2	sensor	17	option
Air pressure	ECM	–	option
Lateral g	sensor	–	option
Driver trim	ECM	–	option

Configuration

The Mazdaspeed ECM version has the following settings:

Parameter Setting

Alarms

Oil press	2.5 bar
Fuel press	2.5 bar
Oil temp	110°C
Water temp	110°C
Battery	11.0 volts

RPM

Redline	8,500
Max. scale	9,500

Speed

Wheel diameter	645 mm
----------------	--------

Units

Pressures	bar
-----------	-----

Beacon **Yes**

Pinouts *Custom pinouts:*

Pin	Description
13	ECM ground
32	ECM data in

Features

The User channels are available for monitoring, for instance, steering and throttle position.

The low power warning feature has been disabled to enable the dash to be tested without the ECM connected.

Lola F3000: 1994–5

Description

The Lola F3000 System 2 variant has a defined User channel for monitoring the position of the sequential gearbox.

Constructor

Lola Cars Ltd
Glebe Road
St Peter's Hill
Huntingdon, CAMBS
UK, PE18 7DS

Dash specification

Pi dash code ref.	30G-0018
Dash descriptor	LOLA
Version(s)	3.70 (July 94)

Club *Expert* PC software

System 2 PC software	Version 1.13 or higher
Club <i>Expert</i> PC software	Version 3.55 or higher

Channels

User 2 is used for the gear position input.

Parameter	Input	Page(s)	Logged
User 2	sensor	1,10	option

Calibration

Mnemonic	Description	voltage	graphed
r	reverse	0–0.19	-1
p	park	0.20–0.72	-2
1	first	0.73–1.32	1
n	neutral	1.33–1.70	0
2	second	1.71–2.27	2
3	third	2.28–3.04	3
4	fourth	3.05–3.90	4
5	fifth	3.81–4.56	5
6	sixth	4.57–5.11	6

Configuration

The LOLA F3000 version has the following settings:

Parameter Setting

Alarms	User 2	de-activated
Names	User 2	GEARP
Units	User 2	volts

Pinouts	<i>Custom pinouts:</i>	
	<i>Pin</i>	<i>Description</i>
	8b	GEARP ground
	10	GEARP signal
	27d	GEARP power

A System 2 potentiometer interface box is required between the gearbox sensor and the System 2 inputs.

Installation

A 360 degree rotary sensor is mounted on the gear box selector drive. The sensor provides a different voltage depending on which gear – and hence the position of the shaft – the driver has selected. System 2 uses a look-up table to correlate the voltage against actual gear position.

Features

The calculated gear position is displayed in the centre of page 1. The voltage from the sensor is also displayed on a separate page to enable calibration to be carried out easily.

User Channel 1 is still available for use by teams.

Rally and Hillclimb applications

Description

System 2 is widely used in rally and Hill climb applications. There are a number of new features that have been developed specifically for the data logging requirements of leading teams.

Configuration

To make full use of the rally and hill climb features on System 2, configure your dash as follows:

Parameter Setting

Speed

START speed	0
-------------	---

Beacon

LAP	RUN
-----	-----

Outing

RALLY

Dash Features

Start logging criteria

By setting the outing speed to zero the dash can log data from standing starts. As soon as a wheel trigger is detected, and the RPM threshold is exceeded, logging begins.

RPM threshold

Due to the loose surface on rally stages, the RPM threshold for logging to commence is reduced to 20 percent of the redline when the dash is configured to Rally mode.

Stop Logging criteria

During left foot braking it is possible for one or two of the rear wheels to lock for more than three seconds. This would normally cause the dash to stop logging and insert a pit Beacon but in Rally mode zero speed must be seen for 10 seconds before a pit Beacon is inserted.

Distance measurement

Because of the risk of wheel lock for prolonged periods, the dash will estimate the distance travelled during such periods, based on the vehicle speed prior to the wheel locking.

Wheel speed selection

To help reduce the risk of prolonged periods where the dash sees a speed of zero, a Wheel speed Selector box (Part Number 01F-152119) can be used to sample two wheel speeds and output the highest value at any time.

If wheel spin is a concern, the Selector box can also select the lowest speed of the two input signals.

Free running stage timer

System 2 has a free running timer (configure Beacon to RUN) which, when used in conjunction with the standing start feature, displays the elapsed stage time to the driver. The time freezes on the display for 10 seconds when an end of stage Beacon transmitter is detected.

Telltale

When driving road stages, drivers prefer that the dash does not switch into telltale mode whenever the car stops. Rally mode switches this feature off.

Club Expert plus Features

Stage Maps

Club Expert plus can draw point-to-point stage maps from data that starts and/or finishes with zero wheel speed. Beacon transmitters should be used to trigger end of stage timing wherever possible.

Slip indicator

The effective 'gear ratio' of the car is calculated by dividing engine RPM by the wheel speed and can be graphed by Club *Expert* PC software. This gives a clear graphical representation of wheel spin or lock along the stage.

In-line acceleration

In-line acceleration is calculated as the rate of change of wheel speed and provides teams with an indication of how well the car is accelerating from the start line or out of corners.

Allocating data to Up/Down laps

Rally cars often run up and down a stage during testing, creating an outing with laps (and maps) from both directions. Club *Expert* allows you to tag each lap as a PIT, UP or DOWN lap and to select which set of laps are viewed. This helps to prevent analysing UP data on a DOWN map.

Karting applications

Description

System 2 can be used on any Kart from cadet class to 250cc. The system is able to show on-board lap times, minimum corner speeds, gear change points, oil pressure and temperature and exhaust gas temperature (EGT).

Configuration

The rolling circumference of kart tyres vary significantly by batch and as a result of temperature, and this will have an effect on the speed calculated by System 2. Measure tyres and re-configure System 2 to ensure accurate values.

<i>Parameter</i>	<i>Setting</i>
<i>Alarms</i>	
User 1	XXX°CT (set to desired EGT alarm value)
User 2	5.50 volts
<i>Units</i>	
User 1	°CT
User 2	volts
<i>Name</i>	
User 1	STEER
User 2	EGT

Installation

System 2 can be mounted behind the steering wheel in a cradle.

The Beacon receiver can be mounted on top of the dash itself or on the Nassau panel.

The wheel speed sensor is mounted as normal on the front left side wheel. You will need to make up a custom bracket for this.

Depending on your kart, you may require engine sensors. These are mounted as standard.

If you are using the Thermocouple, set the alarm value to the chosen upper threshold temperature.

Turbo and carburettor pressure measurement

Description

System 2 has been updated to enable a low range pressure sensor to be used on either of the standard pressure channels (e.g. oil or water pressure).

The low pressure sensor is calibrated from 0 to 40 psi. The channels are alarmed when pressure falls below the preset threshold. In the case of turbo measurement the alarm can be set to come on when the turbo drops below a preferred value.

Dash specification

Dash descriptor	F3
Version(s)	3.66 or higher

Configuration

To use the low pressure sensors on both channels, the dash would be configured as follows:

<i>Parameter Setting</i>	
<i>Units</i>	
OIL-P	TBR
FUEL P	TBR

Installation

A System 2 low pressure sensor can be ordered from your Pi representative (Part Number 21A-0050). The sensor can be used to measure turbo pressure or carburettor pressure.

Features

The dash displays the chosen pressure channel as TURB1 (oil pressure) or TURB2 (fuel pressure) and will issue an alarm to the driver if the turbo or carburettor pressure falls below the preset threshold. The alarm will cancel if the value rises above the limit for one second.

Club *Expert plus* features

The pressure values can be recorded (if configured in Graph Logging) and graphed in the Club *Expert plus* PC software.

System 2 video data link

Description

All new non-ECM System 2 dashes have the ability to support the data link to an in-car video 8 camera. The dash transmits a data stream at 1200 baud via the ECM Tx port. Data packets are transmitted at intervals of 10 milliseconds (i.e. 100 Hz). Details of the data format are available on request.

Dash specification

Dash descriptor	F3
Version(s)	3.66 or higher

Channels

The following parameters are transmitted from the ECM port:

<i>Parameter</i>
RPM
Wheel speed
Lateral g
Alarm status
Beacon status
RPM redline segment
User 1
User 2
Lap time (minutes)
Lap time (thousandths)
Lap number

Pinouts

Custom pinouts:

<i>Pin</i>	<i>Description</i>
13	ECM ground
33	ECM data out

Installation

A complete installation requires the following components:

*System 2 dash **

Parameter readings are transmitted from the ECM port.

*Modem **

A modem converts the digital signals from the dash into audio signals which are recorded. During playback at a studio, the audio signal is played back through the modem and the digital signals fed into the serial port of a PC.

In-car video

The audio signal is recorded on the spare sound channel of a video 8 camera inside the vehicle.

*PC simulation **

During playback of the in-car video the Club *Expert* PC software produces a VGA image of the dash. An IBM-compatible PC with a 486 processor is required.

Mixing

The VGA image on the PC is converted to PAL and overlaid onto the original in-car video shot and in-car sound.

* Available from your Pi representative

Troubleshooting

Until you are completely familiar with your System 2, you may encounter certain difficulties. This Section lists the most common sources of problems and how to correct them.

If the remedies suggested have no effect, please contact Pi Research or your local Pi representative (addresses are given at the back of this manual).

WARNING: Do not attempt to repair Pi Research equipment yourself. All units must be opened and reassembled in clean conditions by trained personnel. The Warranty will be invalidated if any parts of the System have been tampered with.

Dash

Problem The dash doesn't start up

- | | |
|--------|--|
| Cause | No supply voltage |
| Action | Check the car's master switch and ignition switch. |
| Cause | Flat battery |
| Action | Make sure the car battery is charged up and connected. |
| Cause | The connector on the dash is not secured. |
| Action | Check the D-type connector in the back of the dash is properly located and secured with the slide-lock or screw-lock (depending on the dash version). |
| Cause | Faulty wiring |
| Action | Check that the supply voltage wiring is not damaged or has been shorted out.
(Refer to the Pin connection table in the 'Installation Notes' section.) |

Problem The dash blanks out

- | | |
|--------|--|
| Cause | Supply voltage is dropping below 9 volts |
| Action | Check the battery is well charged. |

Problem The dash blanks out during use

- | | |
|--------|--|
| Cause | Excessive electrical noise |
| Action | Check earthing of ignition or contact Pi |

-
- Cause The power and ground wires on the User channels – if unterminated – may be short circuiting the dash.
- Action Check the User channel wiring is correctly terminated with SureSeals.

Backlighting

Problem The backlight doesn't work

- Cause The backlighting is an optional extra and may not be fitted to your dash.
- Action Send your dash to Pi Research to have backlighting fitted.
- Cause No 12V supply to the backlighting element.
- Action The backlight is powered from a separate 12V supply via the AUX (auxiliary) connector. It can be connected to the lighting circuit on your car, or directly from the battery (in which case it will be on all the time). Follow the instruction in the Installation Notes to connect up the supply voltage.
- Cause The backlighting element has been damaged.
- Action Return the dash to Pi Research for repair.

External buttons and lights

Problem Neither external push buttons work

- Cause The AUX (auxiliary) connector has come apart
- Action Check the AUX connector and re-join if necessary.

Problem One external push button doesn't work

- Cause Faulty wiring
- Action Refer to the Installation Notes to check the wiring to the AUX connector and in the main loom.
- Cause Faulty push button
- Action Try swapping the buttons to see if that cures the problem. If so, replace the faulty one.

Engine speed (RPM)

The dash

Problem The dash is reading half the correct RPM value

- Cause The Pulse setting in the dash is wrong
Action Check and adjust the value in Configuration mode.

Problem The Redline needs to be adjusted

- Cause The Redline setting in the dash needs to be adjusted
Action Check and adjust the value in Configuration mode.

Problem The whole RPM bargraph blanks out

- Cause Intermittent power failure on the dash (You will see the dash going through Power-up mode each time.)
Action Check the connector on the back of the dash and the connections on the car battery and master switch.

Problem Part of the RPM bargraph is blank

- Cause Faulty LCD connection inside the display or damaged LCD: try pressing the screen gently to see if it comes on again.
Action Return the dash to Pi Research. DO NOT ATTEMPT to fix the dash yourself.

Tacho signal

Problem Unstable or absent RPM Bar graph reading

- Cause The dash has not been set up to the correct RPM Type
Action With the dash in Configuration mode /RPM settings, change the setting for RPM Type until the bargraph stabilises. If none of the settings work, contact Pi Research after obtaining a technical specification for the tachometer signal from your supplier.
- Cause The wiring is picking up noise from other sources on the car
Action Check whether the tachometer wiring runs close to other ignition circuits and re-route it if necessary.

-
- | | |
|--------|---|
| Cause | The tachometer signal from the ignition box is noisy |
| Action | Set the Filter setting on the dash to 3 or 7. |
| Cause | The dash is not compatible with your tachometer signal |
| Action | Use the RPM Box instead of your tachometer signal. |
| Cause | Wiring fault |
| Action | Check that the tachometer signal from the ignition box (NOT the HT or LT ignition signals) is connected to pin 2 of the 3-way RPM connector on the System 2 loom. |

RPM Box (HT or LT mode)

Problem The RPM Bar graph is blank or intermittent

- | | |
|--------|---|
| Cause | The dash has not been set up to run with the RPM Box |
| Action | Under the RPM settings set the RPM TYPE to D |
| Cause | The loom connection to the RPM Box may be faulty |
| Action | Inspect the 3-way connector on the RPM Box or System 2 loom and repair, if necessary. |

Problem The RPM reading is occasionally spiky and the PC Software shows small spikes

- | | |
|--------|---|
| Cause | The wiring is picking up noise from other sources on the car |
| Action | Check whether the RPM wiring runs close to other ignition circuits and re-route it, if necessary. |
| Cause | The RPM signal from the RPM Box is noisy |
| Action | Set the Filter setting on the dash to 3 or 7. |

RPM Box HT (High Tension) Connection

Problem The RPM bargraph cuts out or flashes at high RPM

- | | |
|--------|--|
| Cause | The RPM Box is not setup correctly |
| Action | Check that the RPM Box is set for HT (positions 8 to F), and for the maximum sparks per minute that can be emitted by the ignition system. |

Problem The RPM Bar graph is unstable

- Cause The HT connection on the RPM Box may be faulty
Action Inspect the wiring on the HT lead and repair, if necessary.

Problem The RPM reading is obviously too low

- Cause The HT pickup has been wrapped around an HT lead to an individual cylinder instead of the main HT lead and is not picking up the sparks for the other cylinders
Action Wire the HT pick-up around the main HT lead.
-

NOTE: Some engines now have multi-coil systems, where each cylinder has its own coil. In these cases, you can use the HT lead from one coil if the PULSE value on the dash is adjusted accordingly (see the 'Installation Notes' section); alternatively, you could use the LT signal from the ignition box and drive the RPM Box in LT mode.

RPM Box LT (Low Tension) Connection**Problem The RPM bargraph cuts out or flashes at high RPM**

- Cause The RPM Box is not set up correctly
Action Check that the RPM Box is set for LT (positions 0 to 7), and for the maximum sparks per minute that can be emitted by the ignition system.

Problem The RPM Bar graph is unstable

- Cause The LT connection on the RPM Box may be faulty
Action Inspect the wiring on the LT connections and repair, if necessary.

Problem The RPM Bar graph is unstable

- Cause The polarity of the LT connection may be wrong. There are normally three connections on the coil: HT, supply and trigger. The trigger can either be switched to ground or switched to +12V.
Action Connect the RPM Box in line with the other low tension side of the coil (e.g. supply or trigger). This will reverse the polarity of the signal going through the box.

Speed

Problem The speed reading doesn't work at all

- Cause If it has never worked, the wheel speed sensor may need adjusting
Action The sensor must be set within 0.4 to 0.8 mm from the triggers on the wheel.

WARNING: DO NOT OVER-TIGHTEN THE WHEELSPEED SENSOR – it will break. Nip the lock nuts up with a spanner. You are advised not to use a socket set.

IMPORTANT: Although the wheelspeed sensor may appear to work at low speeds, unless the sensor is set within 0.4 and 0.8 mm, the sensor may not work at high speed.

Problem The sensor has been adjusted but it won't work.

- Cause Faulty sensor
Action Visually inspect the wheelspeed sensor for any damage to the head (too close to trigger) or body (over-tightened). Replace if necessary.
- Cause Faulty wiring
Action See the 'Installation Notes' section for details on how to check the wiring for damage.

Problem The wheelspeed is wrong (e.g. by a factor of 2 or 4)

- Cause The sensor is not picking up all the triggers on the wheel
Action Check that all the triggers are set within 0.4 and 0.8mm from the sensor.

NOTE: Because of the tolerance on the suspension of some saloon cars, it is very hard to set up multiple targets within 0.5 mm. In this case, it is best to use a single trigger.

- Cause The wheelspeed Pulse setting is wrong
Action Check and adjust the value in Configuration mode.

NOTE: There are various ways to tell if the wheelspeed sensor is working, depending on the dash version you have. The version number is displayed when the dash is powering up.

Dash version up to 3.0

On the early Dashes, the only indicator of wheelspeed is the Speed Page on the dash. The speed will be shown if it is greater than 10 mph.

1. Lift the wheel with the sensor on it so that it can spin.
2. Spin the wheel and see if you are getting a reading.

Dash versions 3.0 and above

These Dashes have a Debug mode which can be used to help diagnose wheelspeed problems. To access Debug mode:

1. Power-up the dash.
 2. Press and Hold both buttons on the dash.
 3. When **SETUP** appears, release one button momentarily, then press it again. The dash will go blank; you are now in Debug mode.
 4. Click the **CHANNEL** button.
- The word RAW will be displayed with a 0 reading.
5. Spin the wheel (or move the trigger back and forth across the sensor). The reading should go to 1. This indicates that the sensor is working.
 6. Press and Hold both buttons to exit Configuration mode.

Dash version 3.49 and above

These Dashes have an indicator to show when the sensor is picking up the trigger.

1. Go to the Speed setup page in Configuration mode (see the section ‘Configuring the Dash’).
2. Move the trigger across the sensor.
This will cause the Alarm LED to go on.
3. Make sure all triggers are being seen by the sensor.
4. Press and Hold both buttons to exit Configuration mode as normal.

Problem The wheelspeed reading seems inaccurate (e.g. by 5 percent)

Cause The Tyre diameter setting is wrong

Action Check and adjust the value in Configuration mode. This should be the actual rolling diameter of the tyre when it is under load.

Problem Speed and RPM Graphs on the PC Software don't line up

- Cause This is actually a Beacon problem - the data logged by the dash is synchronised by the Beacon position.
- Action Put the transmitter at the same place on the pit wall each time you race at a track: use a name marker or sticky tape.

Using an ABS speed sensor...**Problem The wheelspeed appears incorrect when using an ABS sensor interface box**

- Cause The number of triggers and/or the tyre diameter set in the dash may be wrong
- Action Check the number of triggers on the ABS sensor wheel and re-configure the dash

Problem The wheelspeed trace shown by the Club Expert is corrupted - with spikes or dropouts

- Cause The interface box is earthing to the chassis
- Action Do not connect any of the wires from the interface box directly to the chassis
- Cause The ABS sensor is also trying to drive the car's ABS system
- Action Isolate the interface box wiring from the ABS system with $100\mu F$ capacitors as described in the 'Installation Notes' section.

Using the waterspeed sensor...**Problem The water speed appears incorrect**

- Cause The number of triggers and/or the tyre diameter settings in the dash may not be providing a correct calibration with the boat speed
- Action Adjust the value used for tyre size to change the speed displayed by the dash (try 650mm and 20 pulses per rev). The speed can be calibrated against a hand-held GPS unit.

Problem The waterspeed trace is very 'noisy' even when the boat is in smooth water

- Cause The sensor may have been mounted on the hull in such a way that it picks up turbulence from the prop or fins on the hull
- Action Try mounting the sensor in a different position on the hull as indicated in the installation section

-
- Cause The sensor may be mounted too high on the hull and is being driven by the air flow under the hull
Action Move the sensor lower on the hull

Problem The waterspeed trace is ‘noisy’ during rough water racing

- Cause The sensor may be out of the water for long periods of time. The pickup may be mounted too high so it is being driven by air flowing under the hull.
Action You might be able to remount the sensor lower on the hull to reduce turbulence, otherwise you can smooth the trace with the Club Expert PC software.

Using the wheelspeed selector box...

Problem The speed information is corrupted

- Cause The wheelspeed selector box is picking up noise from the chassis
Action Do not connect the supply 0V (Pin G on the selector box) if the ABS sensors are earthed to the chassis
- Cause The power supply is being taken directly from the battery
Action The 12V supply (Pin J on the selector box) should come from System 2 and not directly from the vehicle battery

Lap times (Beacon)

If you have not purchased a Beacon kit for your System 2, the dash cannot show lap times on the screen.

To test the Beacon system, turn on the dash and transmitter and wave the transmitter in front of the detector on the car. The lap times on the display should change.

Problem Lap times don’t appear on the display

- Cause The dash must be configured to use a Beacon
Action Check and adjust the setting in Configuration mode.

Problem Lap times aren't working (dash shows 0.00)

- Cause The Beacon transmitter isn't being powered; the LED on the Beacon transmitter isn't on
- Action Make sure the battery wiring is secure, and that the battery is fully charged (12V).
-

NOTE: Although a lit LED on the transmitter indicates a good connection to the battery, only a fully recharged battery will supply a strong signal to the car. Make sure you recharge the battery before a day at the track.

- Cause The channels are not correctly set
- Action Make sure that the Beacon transmitter (on the pit wall) and detector (on the car) are set to the same channel. They both have a switch with positions 0 to 9
- Cause The transmitter and detector are not lined up correctly
- Action As the car passes the transmitter, make sure that there is a clear line-of-sight between the two.
- Cause Sunlight is dazzling the detector
- Action The sun – a large infrared Beacon transmitter! – should not shine into the detector as it passes the pits. Place the detector on the other side of the car and move the transmitter to the other side of the track.

Problem Lap times are being corrupted

- Cause If the wheelspeed sensor is not set up properly, the dash will occasionally read zero road speed and insert pit stops in its data. This shows up with very short lap times (e.g. 2 seconds) and corrupted graph data on the PC Software.
- Action Check and adjust the wheelspeed sensor (see section on wheel speed troubleshooting).

Problem The lap times seem wrong

- Cause The car may be picking up someone else's Beacon signal.
- Action Check if any other teams are running with a System 2 Beacon transmitter on the same channel and agree to use different channels.
- Cause The wheel providing speed information to System 2 is locking up for more than three seconds and is causing extra pit Beacons (you will see split laps).
- Action 1. Use a different wheel for speed measurement, or 2. Select Rally mode to prevent premature pit Beacons.

Sensor readings – General

Problem A sensor does not appear to register on the dash. It shows ‘—’ for a value

- | | |
|--------|--|
| Cause | A sensor isn't fitted to your car |
| Action | If you have purchased a car with the dash fitted, ask your supplier which sensors were fitted to the car. For example, you may not have a fuel injection system which requires monitoring. |
| Cause | The sensor is fitted but is not connected to the dash |
| Action | Check the sensor connector and the wiring loom for any obvious damage. |

Temperatures

Mark I Dashes (Nºs 000 to 099)**Problem The temperature readings are wrong**

- | | |
|--------|---|
| Cause | On the Mark I Dashes (black and steel buttons on the dash), the temperature sensors were single pole and required an earth path through the chassis of the car. If installed wrongly, the sensors can give incorrect readings. |
| Action | <i>If the sensors are mounted in a metal block</i> , the earth path is through the sensor body. Make sure that the oil or water piping is connected to the chassis. Water pipes are often insulated by rubber hosing so run a link wire between from the bracket holding the sensor to a point on the chassis. If the sensor is earthed through the chassis DO NOT CONNECT THE SENSOR EARTH WIRE IN THE LOOM. This will cause an earth loop. Leave the earth wire unconnected.

<i>If the sensor has been mounted in a plastic thread</i> , the earth path will be through the earth wire run with the signal wire. With a ring connector, connect the earth wire to the body of the sensor. The sensor is now running from its own signal and earth lines. |

Mark II Dashes (Nºs. 1000 and above)

Problem The temperatures appear wrong

- Cause Water in the sensor, connector or dash connector
Action Inspect and dry, where necessary. Seal temperature connectors with Silicone sealant.
- Cause The temperatures are correct, but different from previous readings
Action Check where temperature sensors were previously mounted: for example, oil sumps may be hotter than filler pipes. If possible, confirm temperature readings at the sensor location with a thermocouple probe.

When measuring temperatures with a thermocouple ...

Problem The thermocouple readings are noisy

- Cause The amplifier is picking up electrical noise from the chassis
Action Make sure the thermocouple amplifier box is not electrically connected to the chassis.
- Cause The amplifier is picking up electrical noise from the chassis
Action Make sure the leads for the thermocouple probe and amplifier do not pass close to high voltage sources such as the ignition coil or magneto.

Pressures

Problem The pressure readings are wrong

- Cause The sensor is faulty
Action Check that the connectors on the pressure sensors are correctly fitted, and going to the right sensor. If necessary, change the pressure sensor.
- Cause The pressure sensor wiring is damaged
Action Check the wiring on the car for visible damage and repair where necessary.

NOTE: If one pressure sensor seems wrong, try putting its connector onto the other sensor. If the fault moves with the connector, then the wiring or dash is faulty. If the fault does not move with the connector, the pressure sensor needs replacing.

When using the turbo/carburettor pressure sensor...

Problem The dash appears to display the wrong turbo or carburettor pressure

- Cause The dash and pressure sensor may be incompatible
- Action If you are using the low range pressure sensor (0 to 2.5 bar) you must have dash code version 3.66 or higher, and the pressure channel units must be configured as TBAR under the UNITS menu in configuration mode. Contact your Pi representative for information on dash upgrades.

Steering position

Problem The steering trace on Club *Expert* is erratic and switches from very high to very low

- Cause The rotary steering sensor may not have been set up correctly or may have gone out of alignment, and is going off-scale during use
- Action While viewing the potentiometer reading on the relevant user channel, align the steering pot so that it reads 2.5 volts when the steering is dead centre. When viewed on Club *Expert* the steering trace should now be centred on 2.5 volts.

Throttle position

Problem The throttle trace does not show full throttle, or subtle movements of the throttle

- Cause The 10 mm throttle sensor is not aligned properly with the throttle pedal and as a result is not picking up certain parts of the pedal movement
- Action Ensure that the stroke of the throttle sensor picks up the final (on-power) 10 mm of movement of the pedal.

Battery

Problem The Low Power warning came up on the dash

Cause The car battery is delivering less than 9V

Action Recharge the battery before running the car again.

NOTE: When the voltage drops below 9V, the dash stops logging data. To make sure the dash logs data again, switch it off and on again with a recharged battery before driving the car.

Accelerometer

Problem The PC Software does not show an accelerometer trace

Cause Early Mark I Dashes did not have an accelerometer fitted

Action Return the dash to Pi to be upgraded.

Problem The accelerometer trace on the PC Software does not show zero along the straight

Cause The dash is not mounted horizontally, which distorts the g-force measured by the dash

Action Check and adjust the mounting of the dash.

Cause The dash is incorrectly calibrated

Action The dash needs to be re-calibrated. Return the dash to Pi for investigation and re-programming .

Data loss or data corruption

Problem The dash does not appear to have logged any data

- Cause The dash did not have time to shut down before it was switched off
- Action Make sure the car stops for three seconds before turning the dash off. (On Dashes with software version 3.53 and above, the Alarm LED flashes after this three second period.)
- Cause The wheelspeed signal (which triggers logging) was not working
- Action Refer to wheelspeed troubleshooting.
- Cause The Outing speed was set higher than the maximum speed reached during the outing
- Action Check and adjust the Outing speed in Configuration mode.
- Cause You may have reset the dash by trying to access Configuration mode from Telltale mode - this forces the dash to print-out its data and then reset. On Dashes with software version 3.53 and above, the dash is only reset if a printer is actually connected to the communication port on the car.
- Action You can retrieve the data using the manual reset feature at any time before the car is driven again (refer to the section 'Using System 2').

Problem Only part of the outing has been logged

- Cause The dash is full. The MAX indicator will be flashing.
- Action Download data to a PC or printer, or manually reset the dash to clear the memory.
- Cause The dash experienced a low battery alarm while the car was being driven, and stopped logging data. Inspect the Outing battery telltale to verify low battery voltage.
- Action Check and recharge the battery on the car.

Problem Too much data appears to have been logged

- Cause The dash was not reset before the last outing
- Action Remember to reset the dash before each outing, especially the first time you run at a new track

-
- Cause The wheelspeed sensor is not working correctly and is inserting pit stops into the data (e.g. when it reads zero speed)
Action Check and adjust the wheelspeed sensor.

Problem **The dash had data in it when the car came in, but after turning the dash off and on again the data was lost**

- Cause On software versions 3.49 and above, there is an Auto reset mode which resets the dash if the dash temperature is within 10° of the engine temperature when it is turned on.
Action You can retrieve the data in the dash using the manual reset feature at any time until the car is driven. Alternatively, change the Outing parameter in Configuration mode to Manual.
Cause If the data was logged and hasn't been downloaded to a PC or printer, the back-up battery may be flat
Action Return the dash to Pi Research to have the internal battery replaced. DO NOT ATTEMPT TO REPLACE THE BATTERY YOURSELF.

NOTE: Internal Battery failure is not a common fault: make sure you have checked everything else before returning the dash.

Telltale

Problem **The dash won't go into Telltale mode**

- Cause The dash cannot go into Telltale mode until the dash has logged an outing.
Action Drive the car first.

Problem **The telltales are incorrect or corrupted**

- Cause Incorrect set-up or operation of the dash
Action Refer to the Troubleshooting section on Data loss or data corruption.

Printing

Problem The dash won't print out its Telltale report

- Cause There isn't any data in the dash
Action Drive the car first.
- Cause The printer isn't plugged into the communication port correctly, or the printer lead isn't plugged into the printer correctly
Action Check the printer lead connections.
- Cause The printer isn't turned on or the batteries/mains are not connected
Action Turn on the printer and check the power supply.
- Cause There isn't any paper in the printer, or the printer isn't on-line
Action Check the paper, and switch the printer on-line.
- Cause The dash can't communicate with the printer
Action Make sure your printer is correctly set up.

NOTE: The dash has the following hardware characteristics:

<i>Interface</i>	<i>Serial RS232</i>
<i>Baud rate</i>	<i>9600</i>
<i>Protocol</i>	<i>XON/XOFF</i>

Problem The printout is corrupted or incomplete

- Cause The printer and dash may not be set up to communicate with each other
Action Check the dash Printer type in Configuration mode and the printer 'Emulation Mode' (refer to your printer manual).

Installation Notes

The 'Installation Notes' section covers the installation procedure for System 2. This section will also be useful to you if you need to fit external switches or backlighting to a car with System 2 already installed.

The installation kit

System 2 comes complete with an installation kit which includes all the connectors, tools and components you will need:

Quantity	Description
5	3-way Sure-Seal socket connectors (Wheelspeed, RPM, Beacon, User channels 1 & 2)
2	2-way Sure-Seal socket connectors (for temperatures)
1	3-way Sure-Seal plug connector (for tacho RPM inputs)
11	Sure-Seal socket crimps
17	Sure-Seal pin crimps
4	8mm crimp terminals (for power connections)
3	Female spade connectors (for 5—120 psi and 0—120 psi pressure sensors)
4	4mm ring tag connectors (for 0—200 psi pressure sensor)
1	Molex connector (options)
14	Molex pin crimps
6m	3mm spiralwrap
6m	6mm spiralwrap
2	M3 x 10 pan head screws (for panel mounted comms connector)
2	M3 brass nuts
2	Shakeproof washers
1	Sure-Seal insertion tool
1	Sure-Seal crimp tool
1	Tube silicone sealant

Part A : Fitting the dash and sensors

Wiring notes

The wire used in System 2 is abrasion resistant and rated to 150°C.

The spiralwrap is rated –10° to +120°C and is used to further protect the wiring and keep it in a neat bundle. When a bundle passes through a sheet metal bulkhead, make sure that there is no risk of the edge cutting into the bundle.

Cables should not be run next to sources of interference, i.e. ignition coils, plug leads, alternators, fuel pumps, radios and ECUs. If it is absolutely necessary to run the cables near any of these, avoid parallel runs if at all possible.

Care should be taken in the routing of the cables around the engine or brake areas, as localised heating when the car is stationary can cause damage to the wiring.

All cars should be wired for the Beacon kit, communications port, and User channels 1 & 2, even if you do not intend to use them immediately.

If your car does not have fuel injection, you should coil up the wiring for the fuel pressure sensor behind the dash: you may need it if you install your System 2 on another car.

Wiring colour codes

The wires in the loom are colour coded: black for ground, red for power and a different colour for signal. However, this does not mean that all black or red wires are the same.

To avoid any problems, System 2 unit should be treated as a separate system and only connected to the car at the battery and Master switch. It should not share its wiring with other systems or items on the car.

Power supply

On racing cars, the negative side of the supply battery is conventionally connected to the vehicle chassis through a Master switch. This allows total disconnection of all electrical power in an emergency, and is required by the regulations governing all motor sports.

System 2 should be connected directly to the ‘safe’ side of the Master switch, to ensure the safety of the installation. The positive supply to the display should be fed directly from the battery ‘live’ terminal, or optionally through a separate switch, which allows the display to remain powered up while the ignition systems are off. This prevents data loss when the engine is stopped by switching off the ignition.

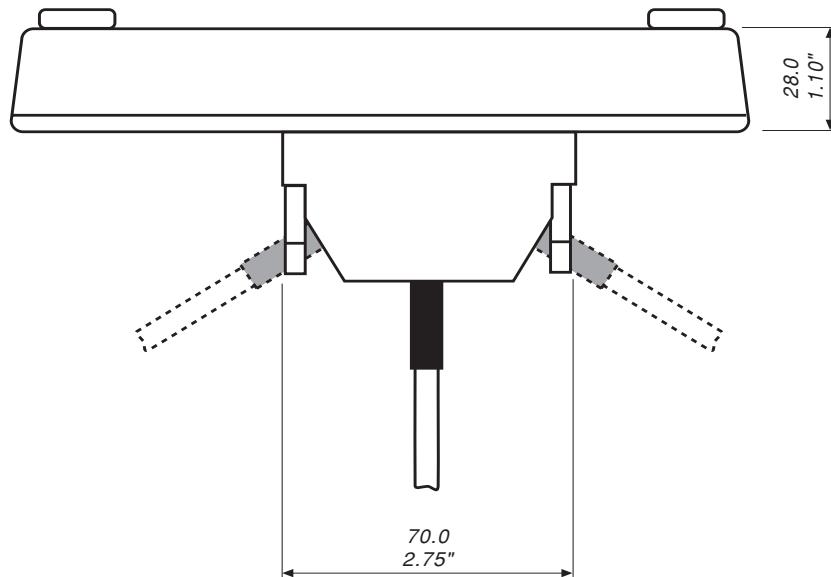
Data will be lost if the Master switch is used to stop the engine, as the System 2 cannot save data in a controlled way under these circumstances.

You can also power System 2 from a separate 12 volt battery when using it, for instance, on a kart.

Mounting the dash

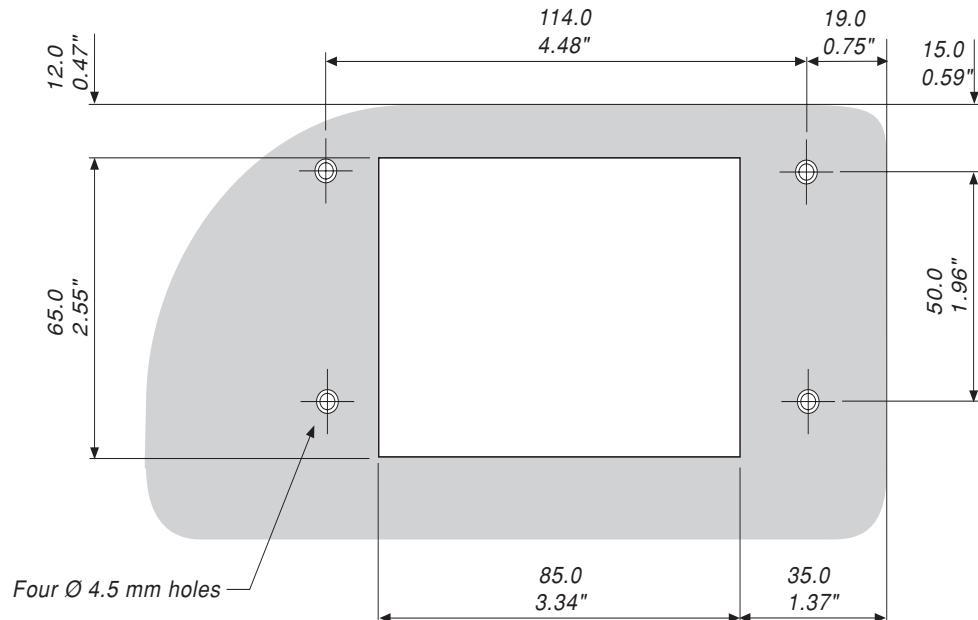
You can either adapt your car's existing dash panel, or make up a new one specifically for System 2.

1. Remove the existing Speed and RPM displays from the car, but leave the wiring in place, if possible.
2. Check the clearance available behind the dash, to make sure there is room for the System 2 loom.



Minimum clearance required at rear of dash

-
3. Mark up the dash panel with an outline of the cutout.



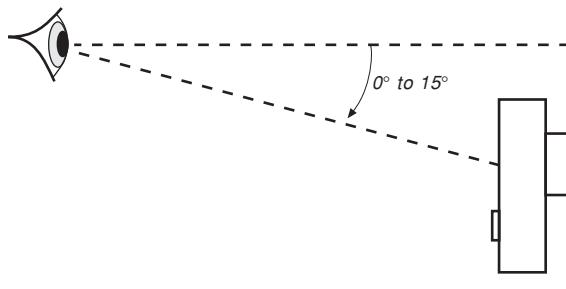
Recommended cutout for dash (viewed from front of display)

Mark up the dash panel with an outline of the cutout required and the location of the four mounting holes.

4. Cut out the profile and drill the location holes.
5. Mount the dash on the panel using the four screws provided.

Notes

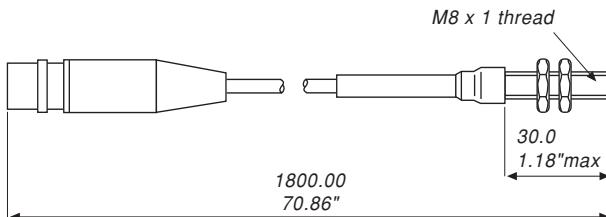
- The dash should be mounted so that the driver can see the display through the wheel.
- The driver should be able to reach the push-buttons on the dash. (External switches and lights can be obtained from Pi Research.)
- The driver should look straight at, or slightly down at, the display.



Dash viewing angle

Wheelspeed measurement

Wheelspeed sensor



Wheelspeed Sensor

Sensing Distance	0.4mm to 0.8mm
Clearance Distance	8mm from any steel object
Mounting	30mm of M8 x 1 thread (DO NOT OVER-TIGHTEN)
Connector	3-pin Cannon Sure-Seal
Sensor connections	Pin 1 (Blue) Ground Pin 2 (Black) Signal Pin 3 (Brown) Power

Failure to have the minimum clearance from other steel objects causes the sensor to register a rotation even though the trigger target has moved out of range. On the other hand, if the working distance is too great, the sensor will miss triggers, especially at slow speeds.

WARNING: The sensor should only be tightened with a small spanner. Over-tightening the sensor will cause it to fracture.

Wheelspeed Trigger

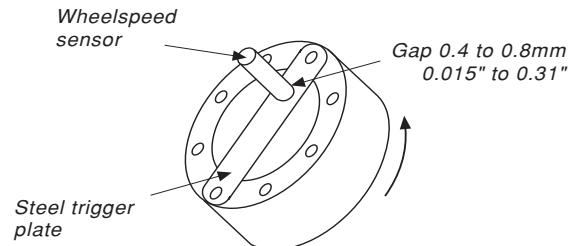
Type	ferrous metal object
Number	1 to 30 per wheel revolution (typically 2 or 4)
Size	nominally 8 x 8 x 4mm

The trigger used to activate the wheelspeed sensor should have a surface approximately the same size as the head of the sensor, and be at least 4mm away from other metal objects.

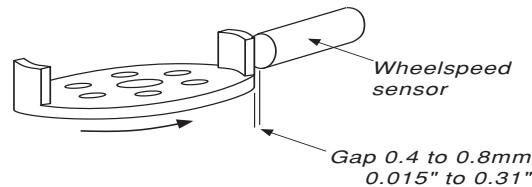
On saloon cars, tolerances of 0.5mm on can be hard to achieve so we suggest you use only one trigger.

The sensor can either be mounted in a threaded block, or with a sheet metal bracket. Make sure the sensor does not vibrate or touch the trigger when the car is driven.

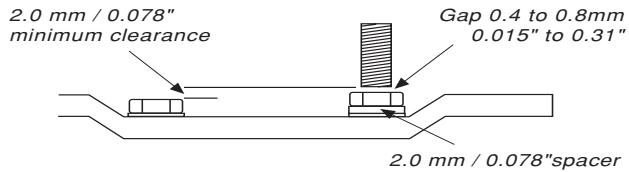
System 2 can be used with a wide variety of cars, so the details of mounting the sensor will vary (installation data sheets for each type are available from Pi Research). Three examples of mounting configurations are shown in the following diagrams.



Top mounted configuration



Side mounted configuration



Wheel stud mounted configuration

Wheelspeed sensors

1. Make a bracket for the wheelspeed sensor and mount the sensor on the car.

The sensor is normally mounted on the front nearside wheel, since this experiences the least wheel lift or lockup.

Do not over-tighten the wheelspeed sensor, and avoid mounting the sensor too close to the brake disc (to avoid superheating).

2. Secure the cable of the sensor on the wishbone and into the front nose cone (on a formula car), or through to the engine bay (on a saloon car).
3. Cover the wheelspeed sensor cable with spiralwrap.

Make sure the cable is not tight when the wheel moves or the wishbone is lowered.

4. Mount the wheelspeed trigger on the wheel.

See earlier description of trigger types. Make sure that the sensor head does not touch any of the triggers.

5. Set up the sensor with an approximate gap of 0.7mm.

RPM measurement

System 2 can measure the engine RPM in three ways:

- digital 'tacho' signals (e.g. Vauxhall Junior, F3 or F3000 with electronic ignition),
- the System 2 RPM box with Low Tension (LT) input (e.g. standard contact breaker ignition systems),
- the System 2 RPM box with High Tension (HT) input (e.g. electronic ignition systems where no tacho signal is available).

The RPM Box generates its own tacho signal from the LT or HT signals on the car.

Tachometer Signals

The System 2 dash unit can accept a 'tacho' feed from most electronic ignition modules.

The settings for the dash (selected in Configuration mode) are:

- A** for Open Collector PNP Pull Down (12V)
- B** for Open Collector PNP Pull Down (5V)
- C** for Open Collector NPN Pull Up (12V) or 12V pulse feeds
- D** for Open Collector NPN Pull Up (5V) or 5V pulse feeds

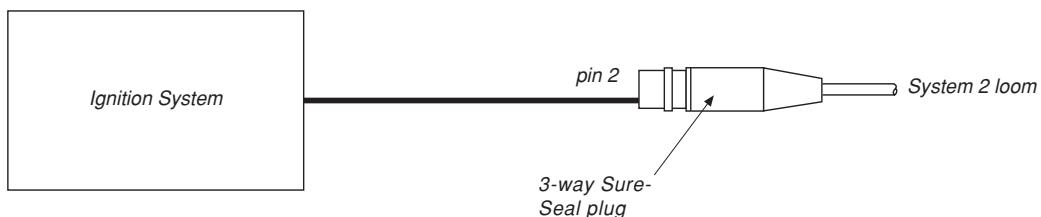
The RPM Box also requires setting **D**.

Connector 3-pin Cannon Sure-Seal

Connections Pin 2 (Violet) Signal

A spare connector has been included in the installation kit. Only pin 2 needs to be connected; the ignition system and System 2 must share the same earth.

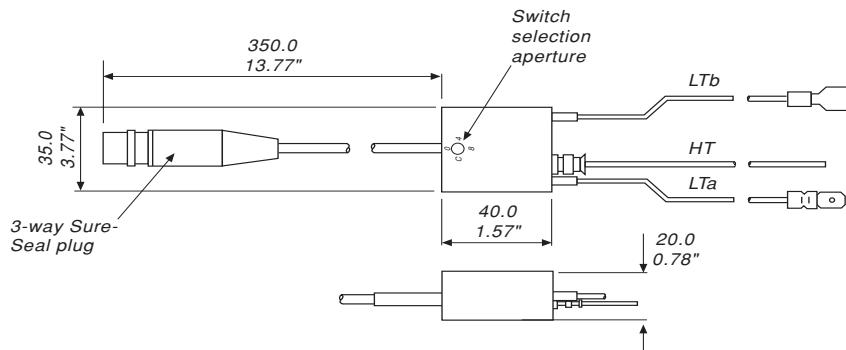
If you have a low voltage digital tacho signal on your car (from the ignition system), locate the wire and connect it to pin 2 of the 3-way Sure-Seal plug connector supplied.



Tachometer connections

When the loom is installed, the tacho signal will be connected to the signal input on the RPM connector.

The RPM Box



RPM Box

Mounting	Industrial Velcro®
Connector	3-pin Cannon Sure-Seal
Connections	Pin 1 (Green) Ground Pin 2 (Blue) Signal Pin 3 (Red) Power

The RPM box either picks up current pulses from the LT side of the coil, or voltage pulses from the master HT lead.

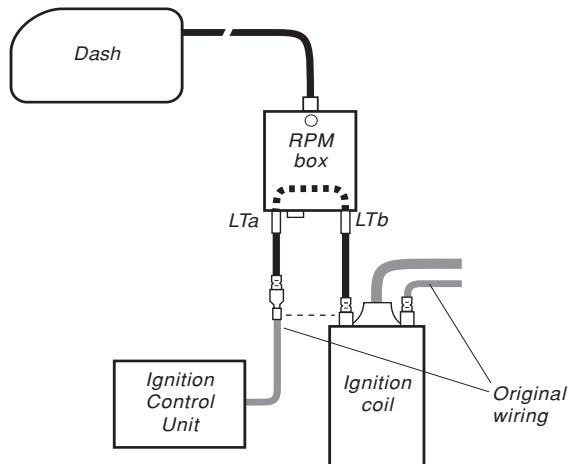
WARNING: To prevent damage, neither of these sources should be directly connected to a System 2 dash.

The RPM Box should be fixed using Industrial Velcro®, near the ignition coil but not mounted to it. A suitable mounting position can usually be found which allows the LT connection to be made without extending the wiring provided.

RPM Box LT connection

The LT (Low Tension voltage) connection on the RPM Box has two flying leads.

1. Remove the connection from the coil to the ignition unit and connect one of the flying leads on RPM Box to the free end of this wire.
2. Connect the other lead from the RPM Box to the coil.



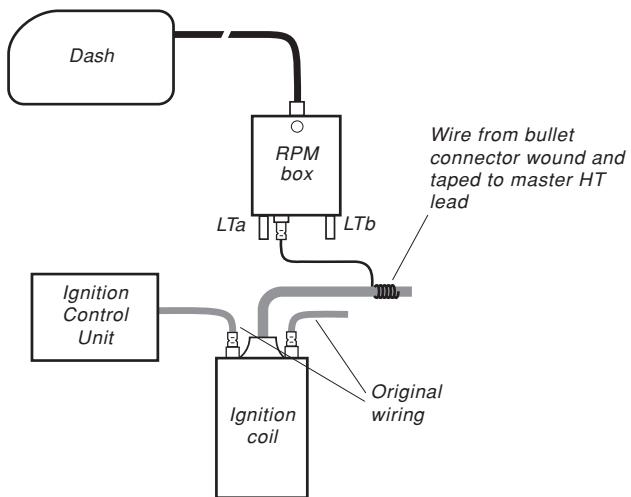
The RPM Box connected using LT leads

Notes

- The wires coming from the RPM box are two ends of a piece of wire; there are no electrical connections inside the box. The ignition signal is unchanged, as long as the connections are good.
- The RPM Box can be sensitive to the direction of the current pulse it receives. If this causes a problem, try connecting it into the other terminal of the ignition coil. This reverses the direction of the current flowing in the wire and should resolve the problem.
- If the spade connectors on the RPM Box do not fit the terminals on your car, we suggest you replace the connectors on *our* box. You can then remove the RPM box at a later date, if you wish.

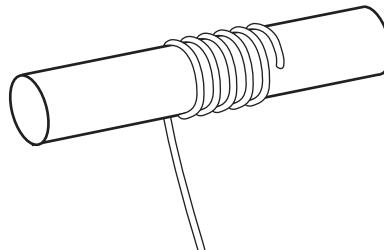
RPM Box HT connection

The HT (High Tension voltage) connection consists of a single wire running from the bullet connector in the RPM Box and wrapped around the HT lead of the car. A piece of wire (high temperature rated) with a bullet connector has been included with the RPM Box for this purpose.



The RPM Box connected to HT lead

The wire should be wrapped around the master HT lead about five times: any excess can be clipped off and then secured with tape. The RPM box LT connections are not used and can be joined together and taped up.

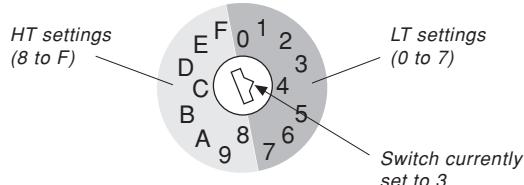


HT pickup – detail

NOTE: The RPM Box is sensitive to the polarity of the HT pulse it receives. If this causes a problem, try using the LT pickup method.

Setting up the RPM Box

The dash needs to be set up to use the signal from the RPM Box. This is done by setting the RPM Pulse type to D. The RPM Box has a small 16-position switch which needs to be set to match the signal received. Legends for positions 0, 4, 8 and C (=12) are printed on the box, but the intermediate settings are available. Settings 0 to 7 should be used with LT (ignition coil) connections. Settings 8 to F should be selected if using the HT connection.



RPM box switch settings

The settings are related to the number of sparks per minute the engine needs at maximum RPM, as in the following table:

Max. sparks/min	LT	HT	Typical example
11,000	0	8	11,000 RPM 2-stroke (11,000 sparks/min)
19,000	1	9	7,500 RPM 4-stroke (15,000 sparks/min)
36,000	2	A	V8 single coil 4-stroke (30,000 sparks/min)
45,000	3	B	
54,000	4	C	
64,000	5	D	
85,000	6	E	
95,000	7	F	

Notes

- RPM measurement is more reliable when unwanted signals are filtered out.
Setting the box sets the frequency at which signals are filtered out, e.g.
Setting 1 filters out signals higher than 19,000Hz.
- If the RPM reading on the dash starts to flash at high RPM, try increasing the setting by one or two positions.
- Do not be afraid of experimenting until you find the correct setting for your car, as an incorrect setting will not damage the unit.

Example Setups

4-cylinder 4-stroke

A 4-cylinder, 4-stroke engine generating 2 sparks/revolution, at 7500 RPM maximum requires the RPM Box to respond to 15,000 sparks/min. The switch then needs to be set to 1 for LT pickup or 9 for HT pickup.

RPM Box	1 (LT)	9 (HT)
Dash RPM Settings:		
TYPE	D	[for RPM box]
PULSE	4CYL	[pulses per cycle]

1-cylinder 2-stroke

A single cylinder, 2-stroke engine generating 1 spark/revolution, at 11,000 RPM maximum requires the RPM Box to respond to 11,000 sparks/min. The switch on the RPM Box needs to be set to 0 for LT pickup or 8 for HT pickup.

RPM Box	1 (LT)	8 (HT)
Dash RPM Settings:		
TYPE	D	
PULSE	2CYL	

The dash assumes a normal 4-stroke engine that runs from one ignition coil. 1-cylinder 2-stroke engines fire on every rotation and appear as 2-cylinder engines.

4-cylinder 4-stroke with double coils

A 4-cylinder, 4-stroke engine with double coils generating 1 double spark/revolution per coil, at 13,500 RPM maximum requires the RPM Box to respond to 13,500 sparks/min. The switch then needs to be set to 1 for LT pickup or 9 for HT pickup.

Care must be taken to ensure that the RPM Box only picks up signals from one of the coils. Then set the RPM PULSE to 2.

RPM spike filtering

In cases where there are noise spikes on the RPM trace or telltale, the dash can be set to filter them out.

Under the RPM settings in Configuration mode, there is a parameter called SPIKE FILTER. It has three settings: OFF, 3 and 7:

OFF is the normal unvalidated RPM mode which works in most situations.

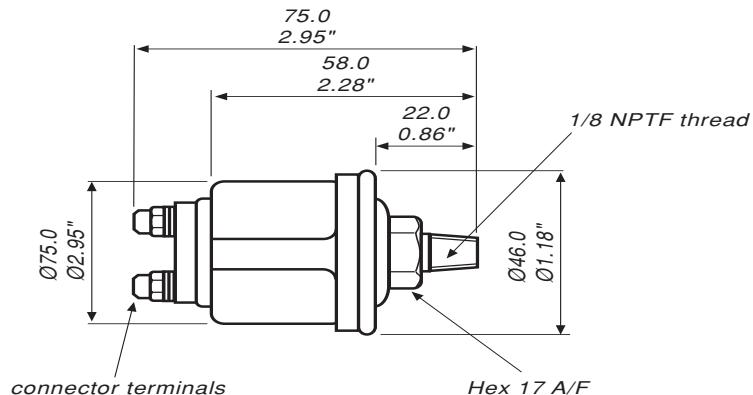
3 should be used for 1 or 2-cylinder engines that give spiky traces.

7 should be used for engines with 3 cylinders or more.

Notes

- Because of the filtering method used, clutch slip, over-rev on down shifting, etc. are not masked.
- Filtering is only intended to remove the odd spike and cannot clean up a consistently bad signal. It can only remove single spikes; double spikes will be displayed. For this reason, the installation should be checked for sources of interference before using the filter.

Pressure measurement



Pressure Sensors (dimensions in millimetres and inches)

Standard Pressure sensor for black coloured dashes up to serial number 3006

Operating Range	5 to 120 psi 0.35 to 8.44 Kgf 0.34 to 8.27 bar
Mounting	7mm 1/8 NPTF thread
Connector	2 off 1/4" female blade
Connections	non-polarized
Explosion rating	35 bar

The same sensors are used for fuel and oil pressure measurement. The colour coded wiring on the loom determines how they should be connected (see Part B: Fitting the wiring loom).

The connections on the sensor are spade terminals and are unpolarised. They can be connected either way around

Pressure sensor for blue coloured dashes from serial number 4000 onwards

Operating Range	5 to 200 psi 0 to 14.07 Kgf 0 to 13.78 bar
Mounting	7mm 1/8 NPTF thread
Connector	2 off 4mm ring tag
Connections	non-polarized
Explosion rating	35 bar

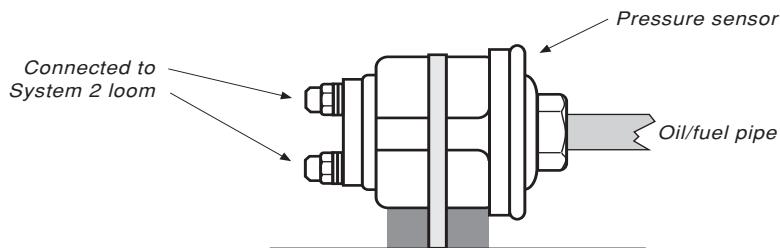
The same sensors are used for fuel and oil pressure measurement. The colour coded wiring on the loom determines how they should be connected (see Part B: Fitting the wiring loom).

The connections to the sensor are made using 4mm ring tags. They are unpolarised and can be connected either way around.

Mounting the pressure sensors

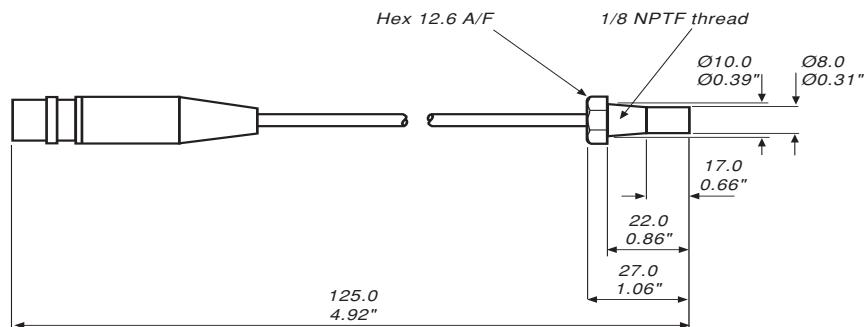
Indirect fitting

Mount the pressure sensors on a side pod near to the fuel/oil pumps using tie-wraps and rubber pads.



Indirect fitting of pressure sensors

Temperature measurement



Imperial thread Temperature Sensor

Temperature sensor (Imperial)

Operating Range	0° to 150° (32° to 302°F)
Accuracy	±2.5°C (±4.5°F)
Mounting	7mm 1/8 NPTF thread 17mm extending past thread
Connector	2-pin Cannon Sure-Seal
Connections	Pin 1 (White) Signal Pin 2 (Red) Power

WARNING: The sensors can be adversely affected by water. Waterproof connectors have been supplied, but it is essential to use the silicone sealing compound to prevent water reaching the connectors from the loom wiring.

If water penetrates the connector, dry it out, reconnect, then seal using a silicone sealant.

The sensors for water and oil temperature are exactly the same. The colour coded wiring on the loom determines how they should be connected (see Part B: Fitting the wiring loom).

Mounting the temperature sensors

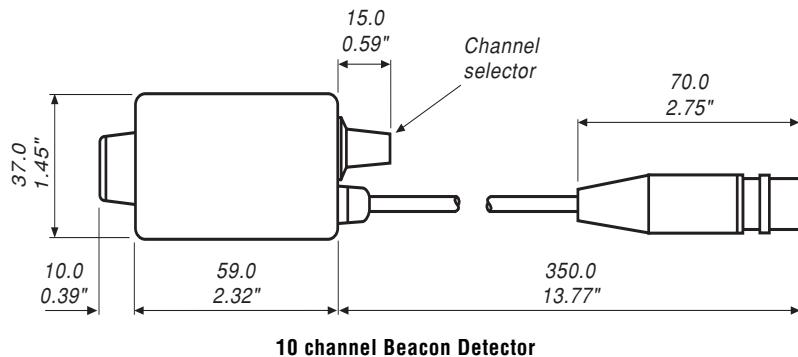
Mount the oil and water temperature sensors in the piping of the engine.

The water temperature sensor is normally mounted in the piping of the cooling system, either in an existing mounting point or by braising and threading an extra one.

The oil temperature sensor is normally mounted either in the sump area or in the piping of the oil pump.

NOTE: The sensors have their own earth, so earthing the body of the sensor or isolating it from the car will have no adverse effect.

Lap timing



The Beacon detector

Mounting	Industrial Velcro®
Channels	0 to 9
Connector	3-pin Cannon Sure-Seal
Connections	Pin 1 (Green) Ground Pin 2 (Blue) Signal Pin 3 (Red) Power

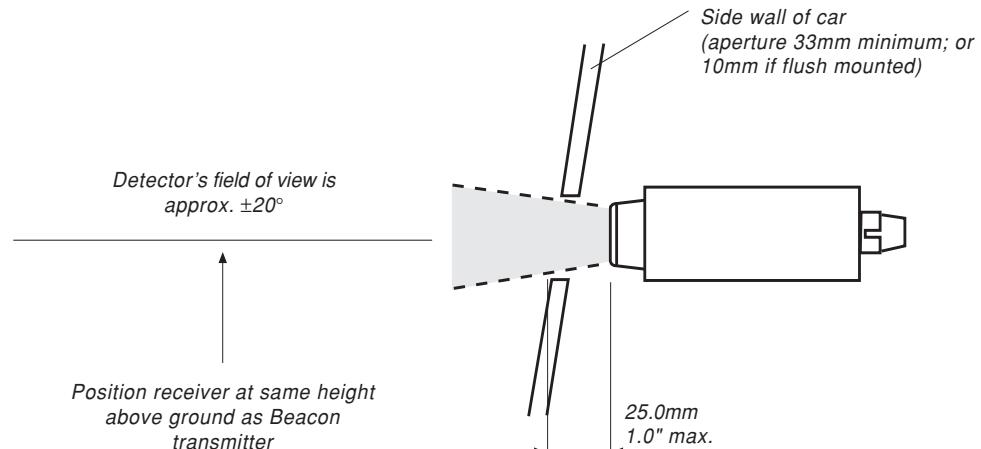
Notes

- The Beacon detector should be mounted at right angles to the ground and at right angles to the direction of the car in motion.
- Where possible, the detector should be mounted flush to the skin of the car, or recessed less than 25mm.
- Where possible, the receiving head should not face directly into the sun while detecting.

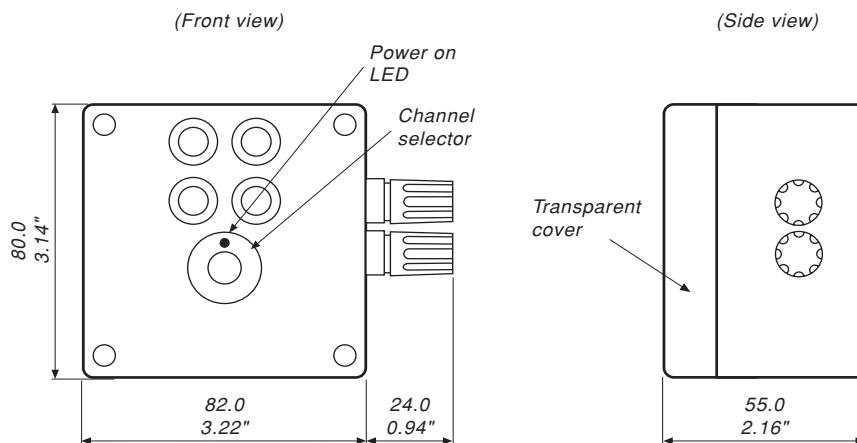
Mounting the Beacon detector

The Beacon detector should be mounted so that it can point at either side of the track. It is often placed by the roll hoop or above the driver's headrest.

The detector is fixed to the car with Industrial Velcro® (supplied by Pi Research).



Beacon detector placement



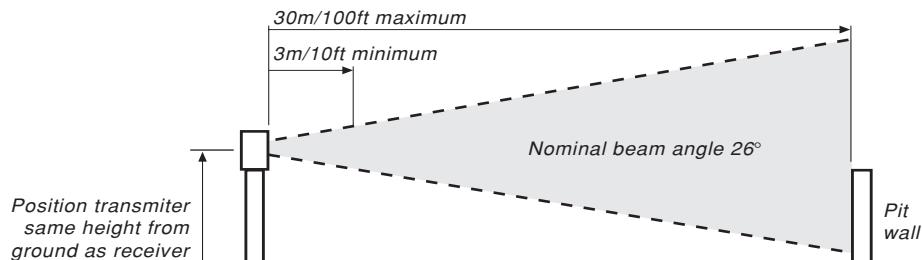
Beacon transmitter

Beacon transmitter

Mounting	Industrial Velcro® or tape
Channels	0 to 9
Connector	2 screw posts
Connections	Red post +12V; Black post 0V

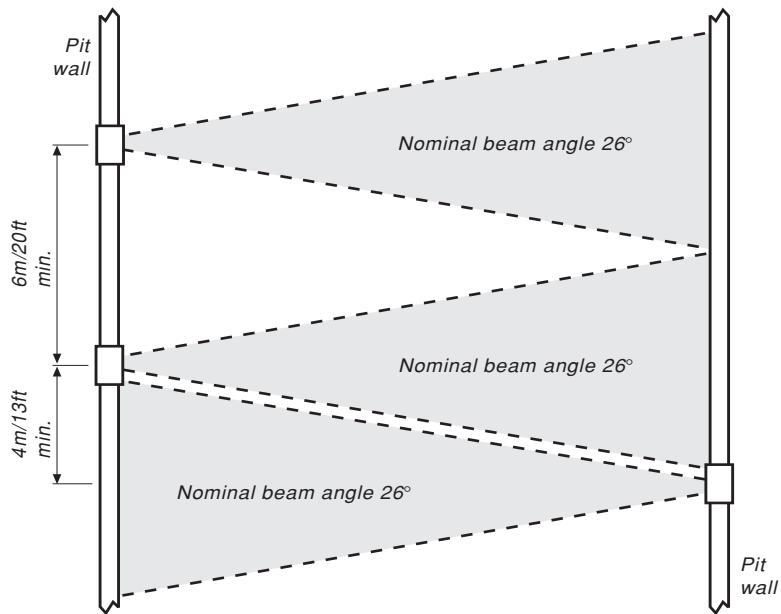
Notes

- A fully charged 12V car battery or rechargeable dry cell battery can be used to run the Beacon transmitter.
- Make sure that the channels selected on the detector and transmitter are the same.
- The transmitter should be mounted at the same height as the detector on the car, with the transmitter beam pointing horizontally and aimed straight across the track. Make sure the detector is not pointing into the sun when it passes the transmitter.



Siting a Beacon transmitter (driver's view)

If several Beacon transmitters are in use at a track do not place them so close together that their beams interfere with one another, as this could give rise to spurious lap times. The following diagram shows the minimum separation distances to be observed.



Minimum separation of transmitter Beacons (plan view)

Optional sensors and interface boxes

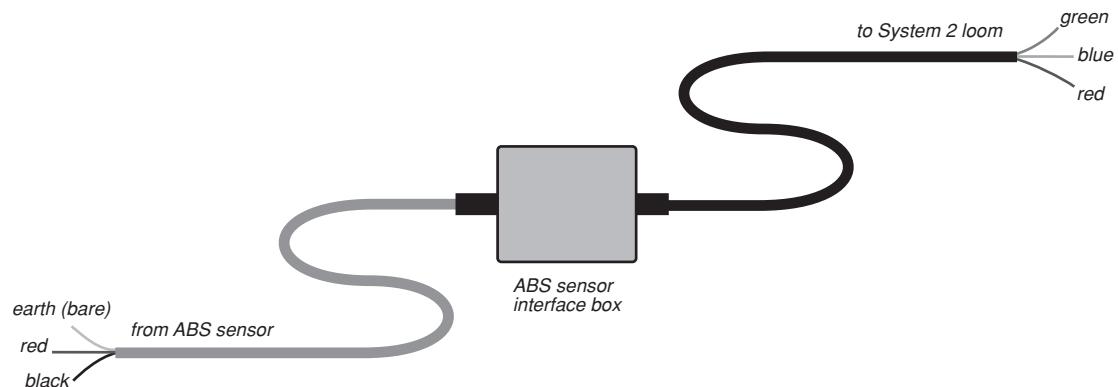
There are range of sensors and interface boxes available for use with your System 2. These can either replace some of the standard sensors supplied, or used on the User channels to add further data logging and display capability.

The table below details which sensors and interface boxes can be used on which channels. Please note that System 2 channels are pre-calibrated and cannot be used with alternative sensors unless they appear in the table.

Standard Channel	Alternative Use	Optional sensors
Wheel speed	ABS wheel speed	ABS sensor interface box
	Boat speed	Waterspeed sensor
	Fastest/slowest wheel speed	Wheel speed selector box
RPM	RPM	Tacho pulse input
Oil temperature	—	—
Water temperature	—	—
Oil pressure	Turbo pressure	Pressure sensor (low)
	Carburettor pressure	Pressure sensor (low)
Fuel pressure	Turbo pressure	Pressure sensor (low)
	Carburettor pressure	Pressure sensor (low)
User 1 and 2	Gearbox temperature	Standard temperature sensor
	Differential temperature	Standard temperature sensor
	Steering position	Rotary potentiometer (360°) *
	Throttle sensor	Linear sensor (10mm) *
	Suspension movement	Linear potentiometer (50–150mm) *
	Exhaust gas temperature	Thermocouple probe and amp
	Sequential gear position	<i>Depends on gearbox design</i>

* Potentiometer interface box required

ABS sensor interface box



ABS sensor Interface Box

Grey lead connects to ABS sensor

Black lead connects to the wheelspeed connector on System 2 loom

ABS sensor interface box

Mounting	Industrial Velcro®
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ABS sensor connections

Maximum input freq.	99 pulses per wheel revolution		
Connector	Unterminated		
Connections	Foil	Screen (do NOT connect)	
	Red	Signal	
	Black	Reference	

System 2 connections

Connector	unterminated or 3-pin Canon Sure-Seal		
Connections	Pin 1	Green	Ground (0V)
	Pin 2	Blue	Signal
	Pin 3	Red	Power (12V)

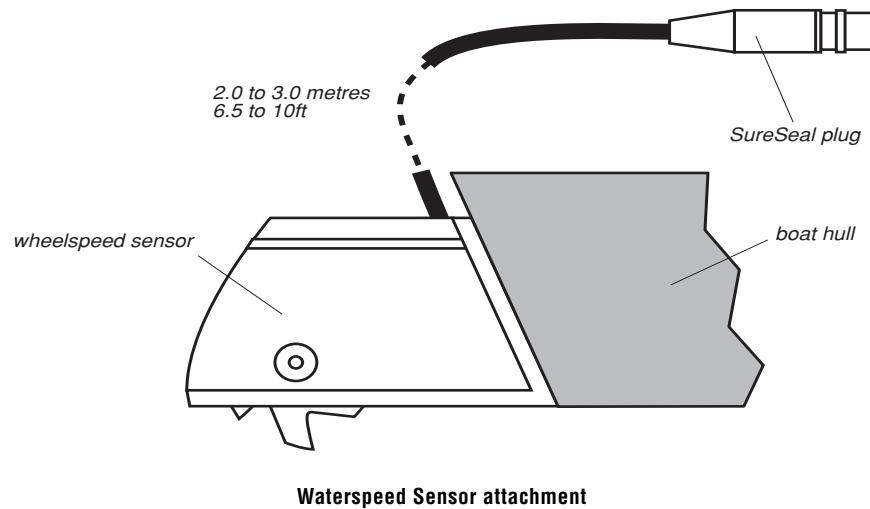
The ABS sensor interface box enables System 2 to take wheelspeed information from an existing ABS (Anti-lock Brake System) speed sensor. ABS speed sensors provide a robust wheelspeed measurement on touring and rally cars where mounting of the standard System 2 wheelspeed sensor might provide difficult.

The interface box has been designed for use with two wire ABS speed sensors (passive type).

WARNING: If the ABS speed sensor is also used by the ABS system on the car, the two wires from the System 2 interface box should be connected to the sensor connections via 100µF 16V capacitors, with the negative side of the capacitor going to the sensor. If in doubt please contact your Pi representative.

Do not connect any wires directly to the chassis of the car.

Waterspeed sensor



Waterspeed Sensor attachment

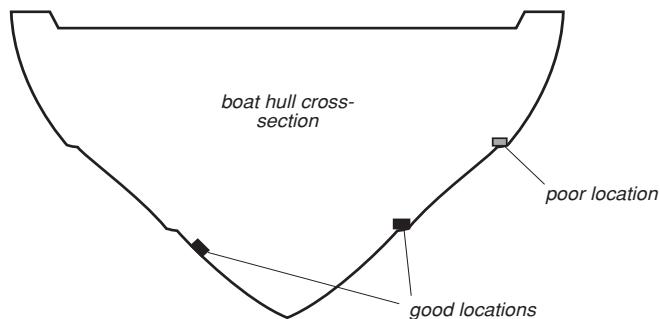
Waterspeed sensor

Sensing type	Hall effect pickup off 6 point paddle wheel		
Mounting	Via two 5mm mounting slots		
Mounting position	On boat's transom in smooth water flow		
Connector	3-pin Cannon Sure-Seal		
Connections	Pin 1	Shield	Ground
	Pin 2	Orange	Signal
	Pin 3	Blue	Power (5–12V)
		Yellow	n/c

The waterspeed sensor can be used to measure boat speed through the water. Although it relies on contact with the water, by using analysis features in System 2, the sensor can measure the effective speed of offshore boats which may be out of the water up to 50 percent of the time.

The sensor should be mounted on the boat's transom where the flow of water is least turbulent. The left (port) side of the transom is preferable; if it is impractical to mount it

there, the right side can be used. Don't mount the sensor behind strakes or ribs, as these disturb the water flow to the speed sensor. Also make certain that the sensor will remain in the water even when the boat is on plane. The sensor is generally mounted about one foot from the boat's centre line.



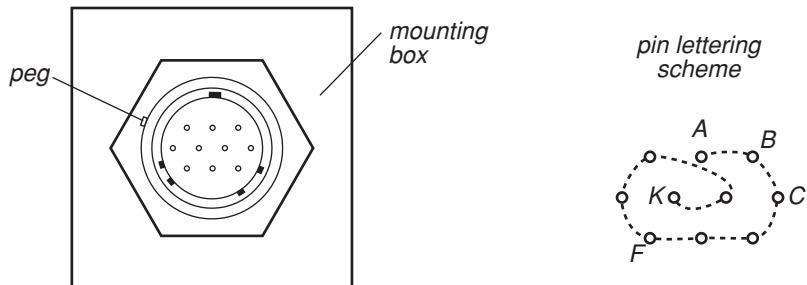
Positioning the Sensor on the hull

When viewing waterspeed on the Club *Expert* PC software, a smoothing filter can be used to reduce spikes in the speed trace.

When setting 'tyre size' and 'triggers' on the dash, try using 650mm and 20 pulses/rev. A hand held Global Positioning System can be used to check the calibration.

If you experience any problems, contact your Pi representative.

Wheelspeed selector box



Wheelspeed selector box connector pinout

Wheelspeed selector box

Mounting	Industrial Velcro®																				
Supply voltage	6 to 18 volts																				
Supply current	4 mA																				
Connector	KPT 2E 12-10P (Cannon or equivalent)																				
Connections	<table><tr><td>Pin A</td><td>Wheelspeed 1 sensor signal</td></tr><tr><td>Pin B</td><td>Wheelspeed 1 sensor reference</td></tr><tr><td>Pin C</td><td>Wheelspeed 1 screen</td></tr><tr><td>Pin D</td><td>Wheelspeed 2 sensor signal</td></tr><tr><td>Pin E</td><td>Wheelspeed 2 sensor reference</td></tr><tr><td>Pin F</td><td>Wheelspeed 2 screen</td></tr><tr><td>Pin G</td><td>Supply 0V from dash</td></tr><tr><td>Pin H</td><td>Fastest wheelspeed signal to dash</td></tr><tr><td>Pin J</td><td>Supply 12V from dash</td></tr><tr><td>Pin K</td><td>Slowest wheelspeed signal (5V only)</td></tr></table>	Pin A	Wheelspeed 1 sensor signal	Pin B	Wheelspeed 1 sensor reference	Pin C	Wheelspeed 1 screen	Pin D	Wheelspeed 2 sensor signal	Pin E	Wheelspeed 2 sensor reference	Pin F	Wheelspeed 2 screen	Pin G	Supply 0V from dash	Pin H	Fastest wheelspeed signal to dash	Pin J	Supply 12V from dash	Pin K	Slowest wheelspeed signal (5V only)
Pin A	Wheelspeed 1 sensor signal																				
Pin B	Wheelspeed 1 sensor reference																				
Pin C	Wheelspeed 1 screen																				
Pin D	Wheelspeed 2 sensor signal																				
Pin E	Wheelspeed 2 sensor reference																				
Pin F	Wheelspeed 2 screen																				
Pin G	Supply 0V from dash																				
Pin H	Fastest wheelspeed signal to dash																				
Pin J	Supply 12V from dash																				
Pin K	Slowest wheelspeed signal (5V only)																				
Fastest signal (H)	Open drain output which can be connected to System 2																				
Slowest signal (K)	Open drain output which can be connected to System 2																				

The wheelspeed selector box monitors any two ABS speed sensors and outputs the fastest and slowest values. The fastest speed should be used in applications where wheels may lock during severe cornering (e.g. touring cars). The slowest speed should be used in applications where wheels may spin due to poor traction (e.g. rallying).

The dash must be set up for the number of triggers on the ABS sensor wheel.

If the ABS speed sensor wires are long or run through an electrically noisy environment, it may be advantageous to use screening braid. This should only be connected to the selector box and must not be allowed to earth to any metalwork on the car.

WARNING: The 12V supply (Pin J) for the selector box should come from System 2, not directly from the vehicle battery.

Do not connect supply 0V (Pin G) if the ABS speed sensors are earthed.

Turbo/carburettor pressure sensor

The low pressure sensor has the same physical dimensions as the standard System 2 pressure sensor.

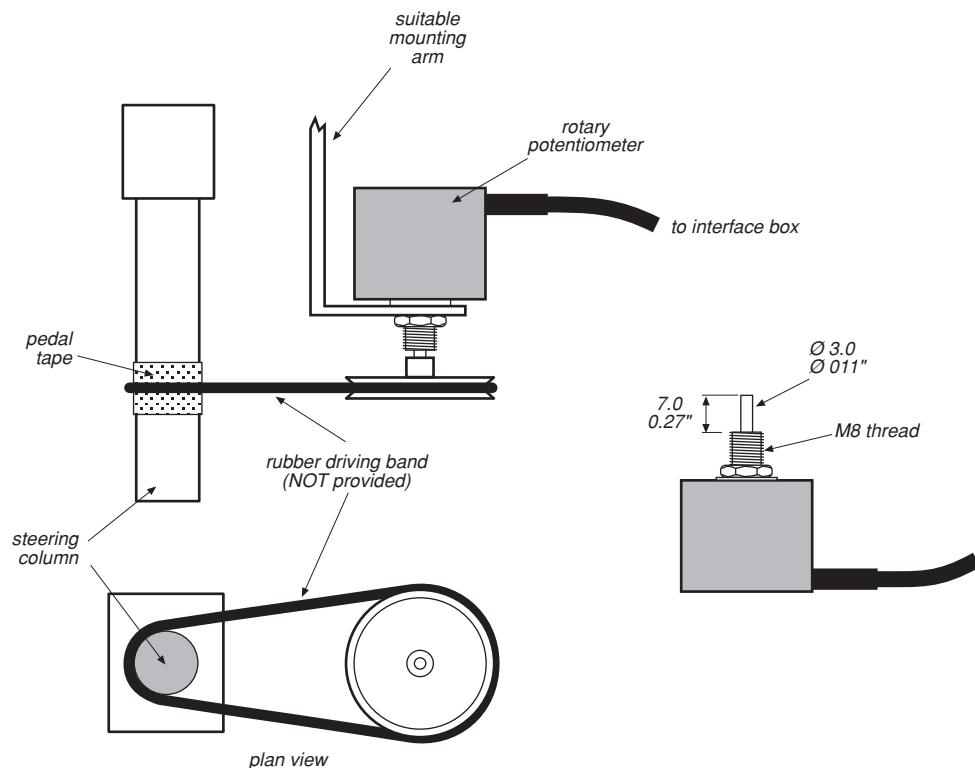
Turbo/carburettor pressure sensor

Operating Range	0 to 2.5 bar
Mounting	7mm 1/8 NPTF thread
Connector	2 off 1/4-inch female blade
Connections	non-polarised
Explosion rating	35 bar

This low range pressure sensor can be used to measure turbo charger pressure or carburettor fuel pressure. The sensor reads down to 0psi (as opposed to 5psi for the standard sensor). Care must be taken when attempting to measure carburettor pressure: pressures caused by lateral or longitudinal g may generate pressure readings to the same level as those caused by draw of the carburettor.

The System 2 dash must have dash code version 3.66 or higher, and the relevant pressure channel must be configured as TBAR under the UNITS menu.

Rotary Potentiometer



Steering Sensor using rotary potentiometer

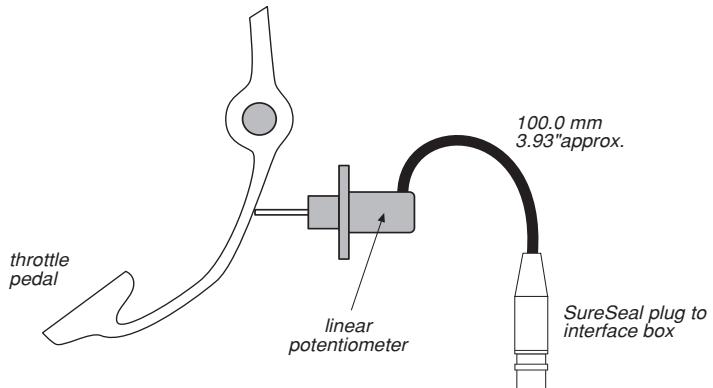
Rotary Potentiometer

Mechanical travel	360° rotary		
Electrical travel	338° rotary		
Mounting	mount with a custom bracket		
Connector	3-pin Cannon Sure-Seal		
Connections	Pin 1	Green	Ground (0V)
	Pin 2	Blue	Signal
	Pin 3	Red	Power (5V)

The rotary potentiometer can be used to measure steering position on a car, or other mechanical movements such as on throttle or suspension components.

A System 2 potentiometer interface box must be used, and the appropriate User channel must be configured for volts.

Throttle sensor



Throttle sensor, using linear potentiometer

Throttle sensor

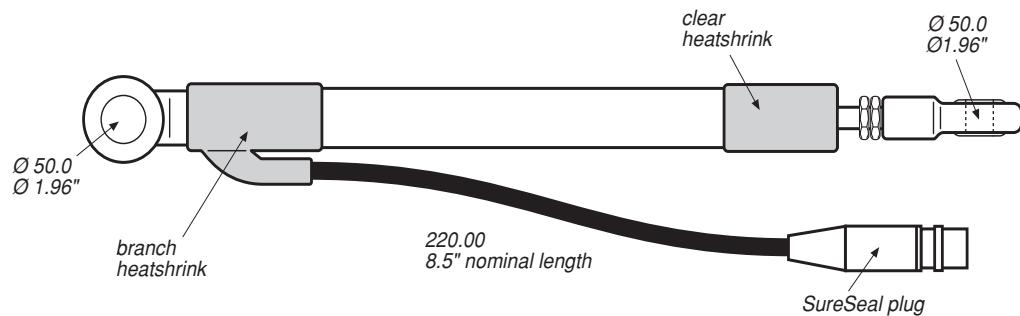
Mechanical travel	12mm linear		
Electrical travel	10mm		
Mounting	Industrial Velcro®		
Connector	3-pin Cannon Sure-Seal		
Connections	Pin 1	Yellow	Ground (0V)
	Pin 2	Red	Signal
	Pin 3	Green	Power (5V)

This sensor is a short stroke linear potentiometer which is typically used to measure throttle pedal movement.

It may be difficult to monitor full pedal movement with the sensor. The sensor should be mounted in such a way as to monitor the latter part of the throttle movement so that you can monitor when the driver lifts from full power.

You must use a System 2 potentiometer interface box, and configure the appropriate User channel for volts.

Linear potentiometers



Linear potentiometer

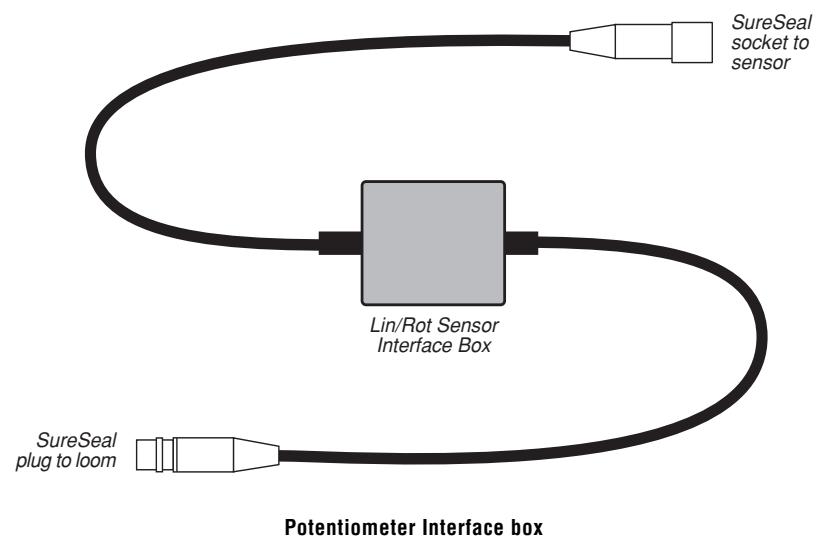
Linear potentiometers

Mechanical travel	50, 75, 100, 125 or 150mm
Electrical travel	50, 75, 100, 125 or 150mm
Mounting	rose joints
Connector	3-pin Cannon Sure-Seal
Connections	Pin 1 Black Ground (0V) Pin 2 Yellow Signal Pin 3 Red Power (5V)

These linear potentiometers are typically used for measuring suspension travel on cars or bikes.

You must use a System 2 potentiometer interface box with each one, and configure the appropriate User channel(s) for volts.

Potentiometer interface box



Potentiometer Interface box

Potentiometer interface box

Mounting Industrial Velcro®

Sensor connections

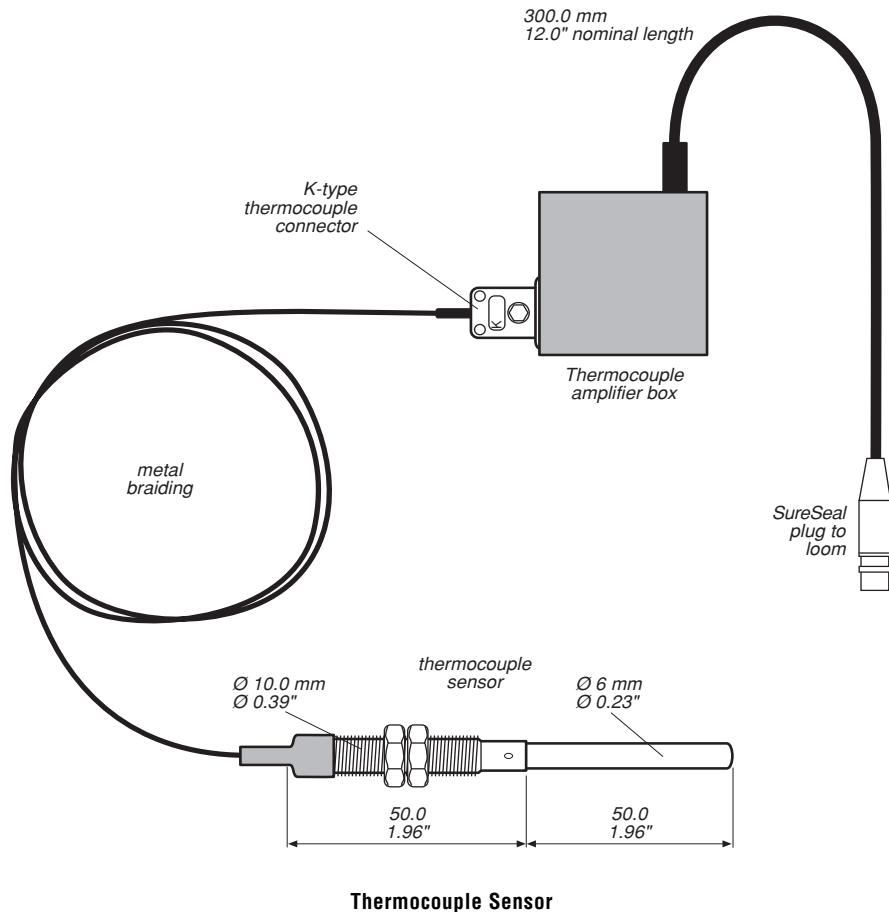
Connector	3-pin Cannon Sure-Seal (socket)		
Connections	Pin 1	Green	Ground (0V)
	Pin 2	Blue	Signal
	Pin 3	Red	Power (+5V)

System 2 connections

Connector	3-pin Cannon Sure-Seal (plug)		
Pin 1	Green	Ground (0V)	
Pin 2	Blue	Signal	
Pin 3	Red	Power (+12V)	

The potentiometer interface box is used to convert the voltage signal from a linear or rotary potentiometer into the signal type required by System 2. The box goes between the 3-pin connector on the loom and the 3-pin connector on the sensor.

Thermocouple sensor



Thermocouple Sensor

Thermocouple probe and amplifier

Probe

Operating range	100°C to 999°C	
Mounting	With lock nuts	
Connector	K-type	
Connections	Blue	-ve
	White	+ve

Amplifier

Mounting	Velcro		
Sensor connector	K-type		
System 2 connector	3-pin Cannon Sure-Seal		
Connections	Pin 1	Green	Ground (0V)
	Pin 2	Blue	Signal
	Pin 3	Red	Power (12V)

The thermocouple is used to measure exhaust gas temperature (EGT) on vehicles with 2-stroke or 4-stroke engines. On 2-stroke karts, EGT is a good indicator of fuel mixture.

Extension leads can be used in conjunction with the sensor, but they must have the same metals and polarity.

Part B : Fitting the wiring loom

By this stage you should have mounted the dash and all the sensors on the car. You are now ready to connect everything together.

Connect the loom to the dash

Take the loom and plug the multiway connector into the back of the dash.

Lay the loom in the car

The wires for each of the sensors are grouped, colour coded and tagged with their identity. Run the wires to each of the sensors on the car. Take care to avoid sharp metal edges and cables carrying high voltages (e.g. ignition circuits).

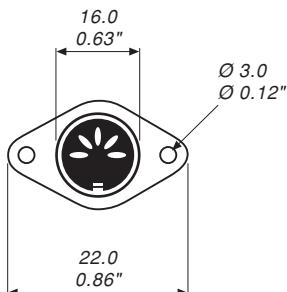
System supply

You may need to untwist the power and ground supply wires if the battery is at the front of the car (connect red wire from loom) and the Master switch is towards the rear (connect black wire from loom).

Beacon

Run the Beacon connections to a suitable position (e.g. by the roll hoop), even if you do not yet have a Beacon kit.

Printer/Comms connection



The Printer/Comms port

The printer cable is already terminated with a 5-pin panel mounting DIN socket. You should mount the socket so it is accessible when the car comes into the pits, e.g. somewhere near the driver.

The AUX connector

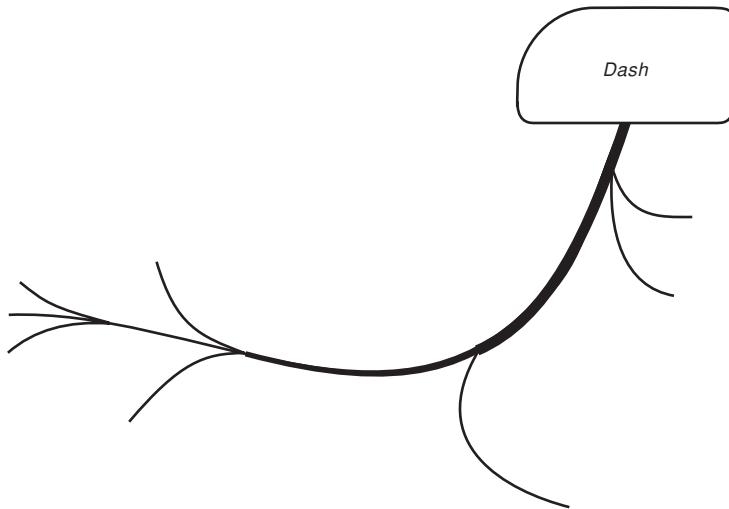
The AUX connector provides for optional accessories – such as external buttons or lights – and should be fixed behind the dash.

Secure unwanted sensor wires

Isolate any wires you are not using near the dash (e.g. fuel pressure) and insulate the ends with tape. Keep the sleeve and wire idents on the loom to facilitate identification at a later date.

Cut the Loom to size

Now that the loom is lying in the car, you can determine how long each group needs to be. Before cutting the wires, the loom should be consolidated by grouping sensor wires together and taking branches where particular sensors require it.



The wiring loom

The final loom will look like a tree. You should use tape at each branch point to hold the loom in shape.

The individual sensor groups are now ready to be cut to length. Use tape to mark the length required, untwist the wires and slide the ident sleeve AND individual wire idents to the marked point. Be sure to leave enough length so that connections are not under stress.

Cut the branches to length and tie the loose ends to prevent the idents sliding off. Cut all the wires to the same length for each sensor.

Fit the connectors and spiralwrap. In most cases, you can do this more easily if you remove the loom from the car.

Fit the Sure-Seal connectors

The Oil temperature, Water temperature, RPM, Wheelspeed, Beacon sensors and User channels are connected to the loom via 2- or 3-pin Cannon Sure-Seal connectors. The loom is connected to the dash via a 37-way D-connector. The connections for each sensor wire are given in the tables below.

Note that on the loom, pin 1 is always a socket; pins 2 and 3 are always pin contacts.

2-pin Cannon Sure-Seal

	Pin1 (socket)	Pin2 (pin)
Oil Temperature	Yellow [34]*	Red [14]
Water Temperature	Blue [36]	Red [15]

3-pin Cannon Sure-Seal

	Pin1 (socket)	Pin2 (pin)	Pin3 (pin)
RPM	Black [3]	Violet [20]	Red [9]
Wheelspeed	Black [7]	White [37]	Red [27]
Beacon	Black [8]	Green [35]	Red [27]
User 1	Black [8]	Yellow [11]	Red [27]
User 2	Black [8]	Blue [10]	Red [27]

* The pin connections of the 37-way D connector are given in square brackets

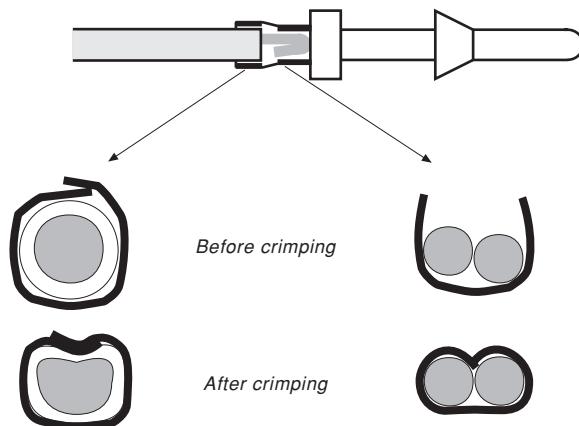
Crimping a contact onto each wire

Take one wire (for example, the yellow wire for the Oil Temp):

1. Strip approximately 8mm of insulation off the wire, taking care not to cut the wire itself.
2. Twist the strands of wire together.
3. Fold the stripped portion of the wire in half to form a tight loop.

-
4. Take a contact (socket for yellow wire [34]) from the plastic bag and place it in aperture 3 of the crimp tool provided.

The two smaller clamping prongs should be facing the 'W' shaped part of the tool.



Waterproof connector crimp connections

5. Push the looped end of the wire right into the contact and crimp it by squeezing the handles all the way together.
6. Fold in the cable grip wings one at a time.

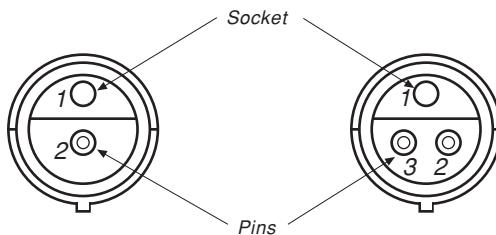
Use the flat front end section of the crimp tool (or a small pair of pliers) to fold in the cable grip wings one at a time, to hold the cable insulation.

7. Crimp the cable grip wings.

Finally, using aperture 3 of the crimp tool, crimp the cable grip wings so that they actually grip the insulation on the wire.

8. Repeat this process to crimp a pin contact onto the red wire for the oil temperature connector.

Insert the contact into the connector



Cannon Sure-Seal connectors viewed from rear

1. Take one of the rubber 2-way connectors from the bag, and locate the contact insertion tool provided.
2. Slide the slot in the tool over the yellow wire (for example) and push the tool up to the neck on the contact.
3. Pick up the connector and push the contact firmly into hole 1 in the body until it is flush with the mating face on the inside of the connector.
4. Check that the contact is correctly located in the body then withdraw the tool.
5. Repeat this process for the red wire, pushing it into hole 2 on the connector.

Repeat the process for each sensor

After the Oil temperature sensor has been connected, repeat the entire crimping and insertion process for the:

- Water temperature sensor
- RPM sensor
- Wheelspeed sensor
- Beacon sensors
- User 1, and
- User 2

WARNING: Failure to terminate any of the wires could lead to a short circuit of the dash.

Fit the spade connectors

Use the spade connectors for 0—120 psi and 5—120 psi pressure sensors.

Unpolarised blade connections

Oil Pressure	Black [16]	Green [18]
Fuel Pressure	Black [17]	White [19]

1. Once cut to length, strip about 5mm of insulation off each wire. DO NOT LOOP the wire.
2. Take a spade connector and grip it gently in the crimp tool. Slide the wire into the connector until it hits the small stop.
3. Squeeze the tool to crimp the connector, making sure that the bare wire is crimped securely.
4. Repeat this process for the remaining wires.

Fit the 4mm ring tags

Use the 4mm ring tags for 1—200 psi pressure sensors.

Unpolarised 4mm ring tags

Oil Pressure	Black [16]	Green [18]
Fuel Pressure	Black [17]	White [19]

Repeat the procedure for the spade connectors detailed above.

Use the knurled finger nut and split washer to secure the ring tag to the sensor.

Note: Ensure that the spit washer is between the ring tag and the knurled finger nut.

Fit the 8mm ring tags

Battery connections

System supply power (+12V)	Red [29]
System supply ground	Black [28]

Repeat the procedure for the spade connectors detailed above.

Fit the spiralwrap

Starting at the sensor/branch ends fit the spiralwrap to the loom, using the small size for 2 or 3 wire groups and the larger size for 4 or more. Wrap all the way back to the connector at the dash end of the loom.

Once the loom has been wrapped it is finished and can be reinstalled in the car.

Reinstall the loom

1. Connect the display, sensors and the power connections to the loom.
2. Check that the polarity of the power connections are correct.

Waterproof the multiway connectors

Once you are satisfied with the installation, the multiway connectors must be fully waterproofed. This is done by sealing the rear of the loom connectors with the silicone sealer provided to stop water penetration. Once applied, leave the silicone to cure for one hour.

WARNING: Failure to waterproof the multiway connectors will not damage your System 2 but certain readings can be affected by water.

Part C: System checks and Power-up

Check the installation

Before turning the dash on, check:

- the clearance on the wheelspeed sensor,
- the freedom of wires from moving parts,
- the silicone sealant on the multiway connectors,
- the connector on the back of the dash, and
- no wires have been left unterminated.

Turn the dash on

When you turn on the Master switch the display powers-up. (Note that on some installations the ignition must also be turned on.)

By clicking the **CHANNEL** button you can step through the values being measured on each sensor.

The road wheel can be rotated backwards and forwards to get the wheelspeed sensor to trigger. On Dashes with software versions later than 3.33, there is a wheelspeed indicator in the section 'Configuring the Dash'.

The RPM display remains blank until the engine is running.

Temperature sensors indicate the ambient temperature. If a sensor is not connected properly the word *COLD* appears on the dash display.

The pressure sensors require engine pressures before showing a value. If a sensor is not properly connected, dashes (- - -) appear on the display.

The battery voltage of the car is displayed, along with the ambient temperature of the dash itself.

Once the dash has been configured to use a Beacon (see below), waving a powered transmitter in front of the detector causes lap times on the display to change. Make sure the channel settings on both devices are the same.

Configure the dash

Before using the dash, you must configure it to show the correct RPM, Speed and Units, etc. If you are using a Beacon, this must also be set on the dash.

WARNING: When you configure your System 2 dash, please take time to write down the settings and have them available when seeking technical support from Pi Research.

Troubleshooting

All the troubleshooting hints are in a separate chapter. If you have any problems with your System 2, refer to the section 'Troubleshooting'.

Part D: The Auxiliary Connector

System 2 has a number of features that can be accessed from the auxiliary (AUX) connector.

Standard features:

- External CHANNEL and MODE/LAP buttons
- External Alarm or Over-rev lights

Factory fitted options:

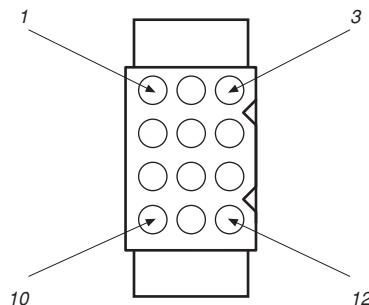
- Backlighting
- Data links to Electronic Control Units (ECUs)

Backlighting fitted to a dash is powered externally, either from the ignition circuit or from an instrument lighting circuit (e.g. in a saloon car).

If you have a custom dash that has had ECU software written for it, the data stream from the ECU is linked to System 2 through the AUX connector.

AUX Connector pin outs

Function	Colour	Molex pin [D-Type ID]
Backlight Power	Red	12 [2]
Backlight Ground	Black	11 [1]
Left Button	Blue	6 [25]
Right Button	White	8 [26]
Left/Right Button Ground	Black	5 [6]
Alarm LED +ve drive	Violet	2 [23]
Alarm LED -ve drive	Black	1 [4]
Over-rev LED +ve drive	Yellow	4 [24]
Over-rev LED -ve drive	Black	3 [5]
Data from ECM	Violet	9 [32]
Data to ECM	Blue	10 [33]
ECM Ground	Yellow	7 [13]



The AUX connector: Customer part (viewed from rear of connector)

Examples of use

Backlighting

Use two pieces of wire (preferably red and black) that are long enough to run from the AUX connector to the power or lighting circuits.

1. Strip and crimp the two wires.

Using the pin contacts provided for the Molex connector, strip and crimp the two wires.
(Follow the instructions for making up the Cannon connectors detailed in part C.)

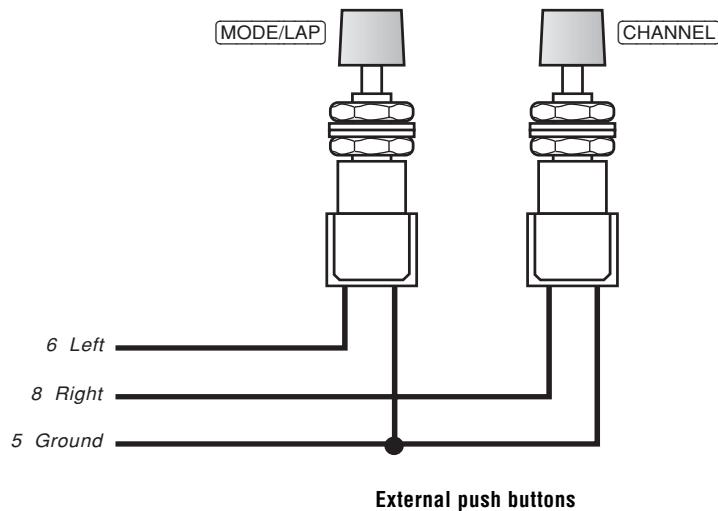
2. Push the crimped black and red wires into the AUX connector positions 11 and 12, respectively.
3. With the Master switch off, connect the red wire to a positive supply, and the black wire to earth.

External push buttons

The external buttons can duplicate the buttons on the dash where access to the dash is constrained.

The buttons are normally open momentary buttons which pull an input on the dash to ground when pressed.

Contact Pi Research to obtain the external button/LED kit.



Part E: Wiring details

Dash wiring Information

The connections on the back of the dash are as follows:

Pin	Colour	Length (mm)	Bundle	Description	Connector
1	Black	300	B	Backlight -ve (0V)	[CON J pin 11]
2	Red	300	B	Backlight +ve (12V)	[CON J pin 12]
3	Black	3000	A	RPM ground	[CON I pin 1]
4	Black	300	B	Alarm LED -ve drive	[CON J pin 1]
5	Black	300	B	Over-rev LED -ve drive	[CON J pin 3]
6	Black	300	B	Left/Right button ground	[CON J pin 5]
7	Black	3000	B	Wheelspeed ground	[CON B pin 1]
8a	Black	2000	A	Beacon ground	[CON C pin 1]
8b	Black	2000	C	User channel 2 ground	[CON M pin 1]
8c	Black	2000	C	User channel 1 ground	[CON L pin 1]
9	Red	3000	A	RPM power (12Vsw)	[CON I pin 3]
10	Blue	2000	C	User channel 2 signal	[CON M pin 2]
11	Yellow	2000	C	User channel 1 signal	[CON L pin 2]
12	Black	2500	A	Printer/PC port ground	[CON A pin 5]
13	Yellow	300	B	Ground from ECM	[CON J pin 7]
14	Red	3000	A	Oil temperature +ve (8V)	[CON F pin 2]
15	Red	3000	A	Water temperature +ve (8V)	[CON E pin 2]
16	Black	2000	A	Oil pressure -ve	[CON G 1/4 F blade]
17	Black	2000	A	Fuel pressure -ve	[CON K 1/4 F blade]
18	Green	2000	A	Oil pressure +ve (8V unloaded)	[CON G 1/4 F blade]
19	White	2000	A	Fuel pressure +ve (8V unloaded)	[CON K 1/4 F blade]
20	Violet	3000	A	RPM pulse in	[CON I pin 2]
21	Red	2500	A	Programming volts in	[CON A pin 4]
22	White	2500	A	Printer detect	[CON A pin 1]
23	Violet	300	B	Alarm LED +ve (12V via 570R)	[CON J pin 2]

24	Yellow	300	B	Over-rev LED +ve (12V via 570R)	[CON J pin 4]
25	Blue	300	B	Left button sense +ve	[CON J pin 6]
26	White	300	B	Right button sense +ve	[CON J pin 8]
27a	Red	3000	B	Wheelspeed power (12Vsw out)	[CON B pin 3]
27b	Red	2000	A	Beacon power (12Vsw out)	[CON C pin 3]
27c	Red	2000	C	User channel 1(12Vsw out)	[CON L pin 3]
27d	Red	2000	C	User channel 2 (12Vsw out)	[CON M pin 3]
28	Black	2000	B	System supply ground (0V in)	[CON D 8mm ring]
29	Red	2000	B	System supply power (12V in)	[CON D 8mm ring]
30	Yellow	2500	A	Data to printer/PC	[CON A pin 2]
31	Violet	2500	A	Data from printer/PC	[CON A pin 3]
32	Violet	300	B	Data from ECM	[CON J pin 9]
33	Blue	300	B	Data to ECM	[CON J pin 10]
34	Yellow	3000	A	Oil temperature sense -ve	[CON F pin 1]
35	Green	2000	A	Beacon pulse in	[CON C pin 2]
36	Blue	3000	A	Water temperature sense -ve	[CON E pin 1]
37	White	3000	B	Wheelspeed pulse in	[CON B pin 2]

NOTE: Wheelspeed Power and Beacon Power are connected together and sleeved. A single wire is then crimped into pin 27.

The wires are grouped into the following bundles, to alleviate strain:

Bundle A – exit 19 wires (19 & 37 side of 37D)

Bundle B – exit 17 wires (1 & 20 side of 37D)

Bundle C – exit 6 wires.

Connector wiring

AUX connector

Pin	Colour	Ident	Function	Length (mm)
1	Black	[4]	Alarm LED –ve drive	300
2	Violet	[23]	Alarm LED +ve (12V via 570R)	300
3	Black	[5]	Over-rev LED –ve drive	300
4	Yellow	[24]	Over-rev LED +ve (12V via 570R)	300
5	Black	[6]	Left/Right button ground	300
6	Blue	[25]	Left button sense +ve	300
7	Yellow	[13]	Ground from ECM	300
8	White	[26]	Right button sense +ve	300
9	Violet	[32]	Data from ECM	300
10	Blue	[33]	Data to ECM	300
11	Black	[1]	Backlight ground	300
12	Red	[2]	Backlight power	300

Printer/Comms Port

Pin	Colour	Ident	Function	Length (mm)
1	White	[22]	Printer detect	2500
2	Yellow	[30]	Data to printer/PC	2500
3	Violet	[31]	Data from printer/PC	2500
4	Red	[21]	Programming volts in	2500
5	Black	[12]	Printer/PC ground	2500

Female Blade connectors (for 5—120 and 0—120 psi pressure connection)

Sensors	Connector	Pins	Colours	Length (mm)
Oil Pressure	G	2	Black [16], Green [18]	2000
Fuel Pressure	K	2	Black [17], White [19]	2000

4mm Ring Tags (for 0—200 psi pressure connection)

Sensors	Connector	Pins	Colours	Length (mm)
Oil Pressure	G	2	Black [16], Green [18]	2000
Fuel Pressure	K	2	Black [17], White [19]	2000

8mm Ring Tags (for power connection)

Function	Connector	Colour	Length (mm)
System power	D	Red [29]	2000
System ground	D	Black [28]	2000

Waterproof ITT Cannon Sure-Seal connectors

Sensor	Connector	Pins	1	2	3	Length (mm)
Oil Temp	F	2	Yellow [34]	Red [14]	—	3000
Water Temp	E	2	Blue [36]	Red [15]	—	3000
Beacon	C	3	Black [8]	Green [35]	Red [27]	2000
RPM	I	3	Black [3]	Violet [20]	Red [9]	3000
Wheelspeed	B	3	Black [7]	White [37]	Red [27]	3000
User channel 1	L	3	Black [8]	Yellow [11]	Red [27]	2000
User channel 2	M	3	Black [8]	Blue [10]	Red [27]	2000

Contact information

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